Hospitality Thermostat

Thermostatic Control Module for Guest Rooms

User Manual Version: [4.0]_a

www.zennio.com

USER MANUAL

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1 INTRODUCTION

1.1 HOSPITALITY THERMOSTAT

A variety of Zennio devices feature a module for performing a thermostatic control of the room by monitoring a set of indicators. Depending on the configuration and the setpoint (or target) temperature, different **commands addressed to the interfaces that interact with the climate system will be transmitted over the KNX bus**, so that the temperature setpoint can be achieved.

The thermostatic control function does not require connecting inputs or outputs to the device as all the communication takes place through the KNX bus.

The Zennio devices may incorporate one of the following thermostat types:

- **Zennio Thermostat**, aiming at performing a general thermostatic control, with multiple, customisable functions.
- **Hospitality Thermostat**, aiming at performing a thermostatic control at hotels, hospitals or other environments with guest rooms.
- **Building Thermostat** and **Home Thermostat**, progressively replaced by the Zennio Thermostat but still available on some devices.

To confirm whether a particular device or application program incorporates the thermostat function, and whether it is one type or another, please refer to its **specific user manual**.

This user manual is exclusively referred to the **Hospitality Thermostat**.

> **Important**: *depending on the device and the thermostat type, the behaviour and the available functions may differ. The user manual of the thermostat module has been particularised for every Zennio device. To access the proper 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 parametrised.*

2 CONFIGURATION

2.1 ON-OFF SWITCH

The Hospitality Thermostat is designed to typically **remain switched on**, performing the room control both when the guest is present (who will only need to care about defining a Comfort temperature setpoint and the desired working mode: Comfort, or a more relaxed mode; optionally, they will also be able to set the Heating / Cooling mode) and also in their absence, being in such case the Building Management System responsible for determining the control parameters.

- However, if desired, it is possible to switch on and off the module by means of a dedicated object, and to define the initial state in parameters.

In addition to the general On/Off control of the thermostat, another object is provided to reflect **whether the fan-coil (or HVAC) unit should remain on or off** according to the current heat or cool demand, i.e., to the value of the control variable of the thermostat. This object can be linked to the fan-coil actuator so it can switch it off at idle periods.

2.2 TEMPERATURE

Prior to describing the thermostatic control process, some basic concepts must be mentioned:

2.2.1 TEMPERATURE SETPOINT

This is the target temperature to be reached in the room. The initial value of the temperature setpoint is set in parameters, although the final user may modify the value according to their requirements at any time.

As explained in later sections, the Hospitality thermostat distinguishes between the **user setpoint** and the **real setpoint**, being the room manager able to introduce a hidden offset between the two values, which will be imperceptible for the final user (see section 2.3.1.2).

The user setpoint control can be **absolute** or **relative**:

- **Absolute Setpoint**: the user sets the exact temperature desired for the room, which is called **User Setpoint**.
- **Relative Setpoint**: the user sets an offset, called **User Setpoint Offset**, which is applied to a basic Comfort setpoint defined by the system.

A **Step User Setpoint Control** is also available for both user setpoint controls to directly set the **User Setpoint** or the **User Setpoint Offset.**

Example of Setpoint types:

Assume a room in cooling mode, whose current temperature is 25ºC and the user want to decrease the temperature by 4ºC. If the setpoint type is absolute, the user will establish the setpoint value to 21ºC, meanwhile with relative setpoint, supposing a basic setpoint of 24ºC, the user will stablish the offset to -3ºC. This type of setpoint is designed so that the user, without knowing the exact setpoint, decides how much he/she wants to decrease or increase the temperature of the room.

In addition, it is possible to enable a **Setpoint to Split** for certain climate machines that require making their own temperature control. This setpoint will be equal to the real setpoint when operating on comfort mode. For all other modes, a parameterisable offset will be applied.

2.2.2 REFERENCE TEMPERATURE

This is the actual ambient temperature registered in the room at a certain time, and it will be the reference to obtain the demand of cold/heat.

Two types of temperature measurements can be taken as reference:

- **Ambient Temperature**: is the temperature acquired through temperature sensors or probes, such as the internal ones in Zennio touch panels or the external probes available for inputs.

  It is also possible to **combine** two different reference temperatures obtained from separate sources, according to different proportions:

Proportion	Source 1	Source 2
1	75%	25%
2	50%	50%

3	25%	75%

Table 1. Combining Reference Temperatures.

- **Apparent Temperature**: temperature calculated from the ambient temperature and the relative humidity, in such a way that it measures the thermal sensation and, therefore, achieves greater comfort for the room.

  The apparent temperature on the Hospitality Thermostat is intended to be used as reference for situations of high humidity, and for those cases, apply the Dehumidification control, explained in section 2.8.

Of course, it is necessary to group under the same addresses the objects intended for the reception of the reference temperatures and the relative humidity, and those through which the values are sent from the devices that measure them (or the **internal temperature probe** object of the same itself, when required).

As with the temperature setpoint, in case the room manager defines a hidden offset, two values need to be distinguished: the **room temperature** and the **effective temperature** in the system (see section 2.3.1.2).

2.3 SPECIAL MODES (Comfort, Standby, Economy, Protection)

The Hospitality thermostat must always remain at a certain *special mode*: **Comfort**, **Standby**, **Economy** or **Protection** (also known as Building Protection).

Each of them defines **its own pair of setpoint temperatures** (one for the Cooling function and one for the Heating function; see section 2.4), pre-set in parameters by the integrator, although modifiable in runtime by the room manager.

Whenever the situation changes (e.g., the room occupancy status), the system will switch to the special mode that best fits the new circumstances:

- **Comfort Mode**: this mode is intended to perform usual climate control, i.e., while there are guests present in the room. Therefore, the setpoint values under this special mode should guarantee their comfort.

- **Standby Mode**: this mode is intended for short periods during which the room remains empty (for example, when the guest leaves the room with the intention of getting back afterwards), or for guests who want to disconnect the climate system. In such case, it is possible to slightly relax the setpoint values to reduce the power consumption.

- **Economy Mode**: this mode is intended for longer periods of no presence in the room. For example, when the room has not been sold yet. Under these circumstances, a setpoint relaxed enough would be appropriate to significantly reduce the power consumption.

- **Protection Mode**: this mode is typically reserved for abnormal situations where external factors are conditioning the room climate control such as repair works or windows being opened. In that case, a considerably low (Heating mode) or considerably high (Cooling mode) setpoint is appropriate so that the climate system can remain off unless extreme temperatures are actually reached.

The thermostat **will necessarily stay at one of the above special modes every time**. When switching from one mode to another, the setpoint temperature will be automatically set to that of the selected mode.

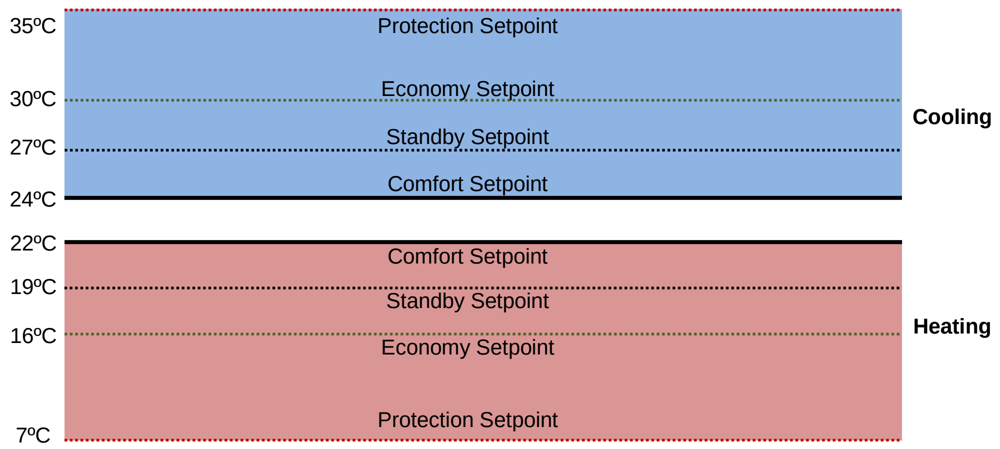


Figure 1. Setpoints and Special Modes

Although the integrator is free to configure any desired setpoint for each special mode, assuring an **efficient configuration** is encouraged. To begin with, it is important to ensure the Standby setpoints fall down between the Comfort and Economy or Protection setpoints.

Nevertheless, the room manager will be **able to modify at any time the setpoints** defined in parameters, by making use of the communication objects provided for that purpose.

2.3.1 GUEST CONTROL vs. MANAGING SYSTEM CONTROL

2.3.1.1 COMFORT SETPOINTS

It is important to note that **only under the Comfort mode the guest can take control over the setpoint or the setpoint offset**, depending on their needs. Under any other special mode, the setpoint is the one defined in parameters or by the room manager.

***Example**: **Special Modes**. Suppose the following setpoint configuration:*

Cooling:	*Heating:*
Comfort Setpoint: 23ºC.	*Comfort Setpoint: 21ºC.*
Standby Setpoint: 26ºC.	*Standby Setpoint: 18ºC*
Economy Setpoint: 28ºC.	*Economy Setpoint: 14ºC.*
Protection Setpoint: 35ºC.	*Protection Setpoint: 7ºC.*

Being in Heating mode and under the Comfort special mode, the guest may set a setpoint of 18ºC (or equivalent for offset: -3ºC) manually, which depending on the configuration and the reference temperature will probably trigger the Cooling mode (see section 2.4.2). If the special mode is then switched to Standby / Economy / Protection, then the setpoint will automatically change to 26º / 28º / 35º.

Therefore, under Comfort two different setpoint temperatures must be considered:

- **Comfort Setpoint**: set in parameters or by object, this is the temperature preferred by the room managing system for Comfort.
- **User Comfort Setpoint / User Setpoint Offset**: this is the temperature preferred by the guest.

2.3.1.2 HIDDEN OFFSET

On the other hand, under the Comfort special mode, the Hospitality thermostat brings the room manager the option **to introduce a hidden offset** over the user setpoint, and to activate or deactivate it by object. This offset, which is imperceptible for the guest, can be useful for power saving, but makes it necessary to distinguish between:

- The **User Comfort Setpoint** or **User Setpoint Offset**, i.e., the value shown to the guest.
- The **Real Comfort Setpoint**, i.e., the value that is actually considered by the thermostat. It is calculated as the User Comfort Setpoint plus or minus

(depending on whether cooling or heating, respectively) the configured hidden offset.

The reference temperature shown to the guest is also affected by the above offset, hence making it necessary to distinguish between:

- The **Effective Temperature**, i.e., the real reference temperature, measured by the external sources, whether ambient or apparent.
- The **Room Temperature** shown to the user. It is calculated by adding or subtracting (depending on whether cooling or heating, respectively) the configured hidden offset to the effective temperature.

2.3.1.3 USER COMFORT SETPOINT CONSTRAINTS

The integrator can impose, in parameters, an **upper limit** (to be applied while in the Heating mode) **and a lower limit** (to be applied while in the Cooling mode) **for the User Comfort Setpoint**, with the aim of preventing the guest from setting temperatures too far away from the System Comfort Setpoint.

Such restrictions are defined in absolute terms: **a minimum temperature** (e.g., 15ºC) and **a maximum temperature** (e.g., 30ºC) that should never be exceeded under the Cooling and the Heating modes, respectively, no matter which the system setpoint is. Note that the latter needs to be greater than the former, to avoid malfunction.

The restrictions **may be hidden to the room guest or not**. In other words, when the User Comfort Setpoint is set to an out-of-range value, the corresponding status object will or will not (depending on the parameterisation) respond with the actual value considered by the thermostat.

Note: *these constraints are applied over the User Comfort Setpoint, which may have been applied a hidden offset, as already explained*.

2.3.2 SWITCHING THE SPECIAL MODE

The thermostat may switch from one special mode to another upon request by object, or automatically after certain events related to the room occupancy or to the window-state objects.

2.3.2.1 THROUGH THE SPECIAL MODE SWITCH OBJECTS

Switching between the special modes is possible through either **four binary objects** (one per special mode), or a **one-byte object**. The former four and the latter work independently: a mode switch order through the one-byte object will be executed unconditionally, no matter which the state of the one-bit objects is, and vice versa.

On their part, these binary objects can behave in two ways:

- **Trigger**: activating a special mode will require sending one “1” through the object corresponding to that mode. Sending one “0” will have no effect.

- **Switch**: activating a special mode will require sending one “1” through the object corresponding to that mode, provided that there are no other mode objects with a higher priority and with that value at the same time (therefore, the value “0” necessarily deactivates a mode). The priority is set according to the following order: **Protection > Comfort > Standby > Economy**.

  Additionally, the integrator can make use of a specific parameter to set the **default special mode** that should remain active in case all the aforementioned one-bit objects are found to have the value “0”.

A parameter is also provided to define whether **leaving from the Comfort special mode should maintain the current operation mode** (Heating / Cooling; see section 2.4) as long as no mode switches are received, or immediately change to the mode that may be active in the room managing system.

2.3.2.2 ACCORDING TO THE ROOM OCCUPANCY

Special mode transitions can take place depending on the following room states:

Sold Room	Occupied
	Unoccupied
Unsold Room	Unoccupied

- **Sold / Unsold**, depending on whether the room has been assigned to a guest or not, according to the room managing system.

- **Occupied / Unoccupied**, depending on whether the guest is actually inside, according to the presence detectors in the room.

Sold / Unsold Transitions

- When the room state changes from **Unsold** to **Sold**, the thermostat assumes it is initially **Unoccupied**, and triggers the **Standby** special mode. The **User Comfort Setpoint** is reset to the system comfort setpoint (see section 2.3.1.1) and the **eco-counter** (see section 2.10) is set to zero.

- When the room state changes from **Sold** to **Unsold**, the thermostat will switch to **Comfort**, **Standby** or **Economy** (depending on the parameterisation), which will also happen whenever a no-occupation state object is received while the room is unsold. Occupation notifications, however, will be ignored during the unsold state.

Note that the **sold / unsold object can be hidden** in parameters. In the absence of such object, the room will be always considered as **Sold**.

Occupied / Unoccupied Transitions

- Whenever a sold room changes from **Occupied** to **Unoccupied**, the special mode will change to **Standby**.

  - The thermostat can **also switch to Economy after a certain time in Standby** without occupation. This Standby-to-Economy time is configurable in ETS or via bus object.

- Depending on the parameterisation, when a sold room changes from **Unoccupied** to **Occupied**, the thermostat will switch to **Comfort**, **Standby**, **Economy** or to the **last active mode** (prior to leaving the room).

  Opting for the **last active mode** requires configuring a **default mode** (either Standby or Economy):

  - <u>In case the last active mode was not Comfort</u>, the thermostat will trigger such default mode.

  - <u>In case the last active mode was Comfort</u>, it is possible to parameterise whether the thermostat can return to Comfort in any case or only if the room remained **unoccupied for less than a certain time** (otherwise, it will return to the **default mode**). Such comfort-to-default-mode time is configurable in ETS or via bus object.

Whenever the thermostat returns to Comfort after the room becomes occupied (either because the last mode was Comfort or by having selected “Comfort” explicitly), It can **restore the previous user Comfort setpoint**, or make the current system Comfort setpoint prevail over it. This is configurable in parameters.

An intermediate approach for the above is also possible: **applying the system Comfort with a delay**. In such case, the thermostat will recover the user setpoint whenever Comfort is triggered after the occupancy of the room, unless the thermostat has remained out of Comfort for some time (configurable in ETS), after which the user setpoint will be discarded.

It is also possible at any time to **reset** the user setpoint to the system comfort setpoint, through a specific object.

On the other hand, once the room is sold and occupied, it can be **locked to maintain the room in the Occupied state**, so the Unoccupied orders from the detectors will be ignored**.** The occupied state will remain until the room become unsold or until the lock is disabled and “Not occupied” is received.

2.3.2.3 DUE TO WINDOW / LOCK EVENTS

The Hospitality Thermostat provides **four window status binary objects**, which can be linked to external sensors reporting anomalous situations (an open window, repair works, etc.) that suggest relaxing the thermostatic control temporarily, and thus **switching to the Protection special mode** (see section 2.3).

The value (0 or 1) associated to the open window status can be chosen in parameters. The arrival of this value will trigger the Protection special mode, which will remain active **until all the window status objects return to the inverse value**, which will recover the mode that was active prior to the window opening event (taking then into account any mode change orders that may have been received while in Protection).

The windows status function can be disabled or re-enabled through object.

One **thermostat lock object** is also provided with similar purpose as the window status objects, but easier to use: when the lock object receives the lock value (1 or 0, selectable in parameters), the thermostat will enter the Protection special mode, and will leave it afterwards when the unlock value (0 or 1, also selectable) is received.

Notes:

- *When the Protection mode has been triggered by means of the usual mode change objects, and not through the window or lock objects, the thermostat does execute **further mode change order** as soon as they arrive, thus leaving the Protection mode.*

- *If the window or lock objects get activated when the current mode **is already Protection**, deactivating the window or lock objects will not make the thermostat leave such mode (unless other mode switch orders had been received in the meanwhile).*

- *Changing to Protection due to an open window or a lock event does not affect the **special mode status objects**, as it is an indirect triggering.*

2.4 OPERATION MODES (HEATING / COOLING)

The concepts explained so far already introduce the fact that there are up to two operation modes available in the climate system (**heating** and **cooling**) and that, consequently, one temperature setpoint for heating and one for cooling are required per special mode.

The integrator should set in parameters whether **heating**, **cooling** or **both modes** are available, so that the thermostat can manage (by sending the corresponding orders to the bus) situations of cold weather and / or hot weather.

If both modes are made available, it will be possible to parameterise a **periodical sending of the two control variables** to the KNX bus, and not only of that of the current mode. In such case, the variable of the non-active mode will be zero.

Moreover, provided that both modes have been enabled, **switching** between them can be done automatically, or through the following binary objects:

- The **User Mode** object defines the current mode in case the current special mode is Comfort.

- The **System Mode** object defines the current mode in case the current special mode is other than Comfort

The above two objects work together so the current mode of the room can be set by the guest while in the Comfort special mode, and by the system (i.e., the room manager) in any other case.

However, in some cases it is useful to block the user mode in order to not allowing to be changed by the guest or by the automatic mode. For this purpose, there is an object to **force the system mode**, provided that the active mode is the comfort especial mode. This object is always available. An example for its use could be:

Example: *In summer the heat generation is disconnected, so if someone demands heating (raising the setpoint with automatic mode changing or through the user mode), the fan coil actuator tries to heat the room. In fact, it would cool with the residual cold of the cold battery. In winter an analogous case would happen. The indicated object would prevent this from happening.*

2.4.1 MANUAL MODE SWITCH

The **manual mode switch** is performed through the combination of the aforementioned objects (user mode and system mode), so that the value **"0"** will trigger the **Cooling** operation mode, while one **"1" will trigger the Heating operation mode**. Whenever the operation mode switches, the thermostat will confirm it by sending the proper status objects, and will adopt the setpoint that, under such operation mode, corresponds to the special mode that may be active.

Under the Comfort special mode, only the **user mode** object will be taken into account, thus ignoring the value of the system mode object, which will only be considered once the special mode leaves Comfort.

Analogously, under any special mode other than Comfort, the user mode will be ignored and only the **system mode** will be taken into account.

The **User Comfort Setpoint Reset** object will restore the object value of user mode, taking the same one that system mode has. The user setpoint is also restored to the value of the system comfort setpoint.

2.4.2 AUTOMATIC MODE CHANGEOVER

Under the automatic mode selection, the Hospitality thermostat assumes the decision of which of the two operation modes is the proper one each time. Mode changeovers are notified to the bus through the corresponding status objects.

There will be an option to choose whether this mode of operation is available **only for Comfort mode** or **for all special modes** (see section 2.3).

In either case, in order to prevent continuous mode changes in the vicinity of the temperature setpoint, it is possible to configure a certain clearance (or margin band) around it. For special modes other than comfort the bands are common to all of them (see section 3.1.1).

The automatic mode selection algorithm is as follows:

- For **all special modes other than Comfort**:
  - The **Heating** mode gets triggered when the effective room temperature is equal or lower than the heating setpoint minus the out of Comfort lower band.
  - The **Cooling** mode gets triggered when the effective room temperature is equal or higher than the cooling setpoint plus the out of Comfort upper band.

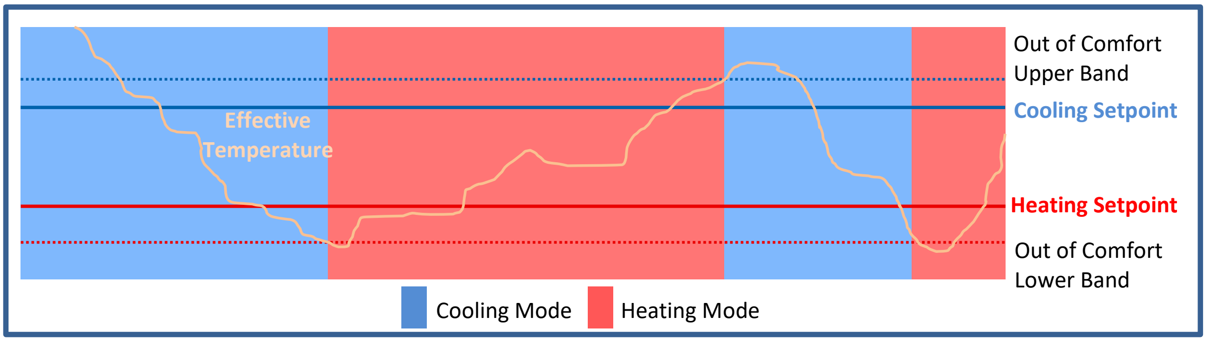


Figure 2. Automatic Mode changeover: Standby, Economy, Protection

The thermostat **will respond to any manual mode change command** but, if conditions require, the automatic mode algorithm could immediately change back to heating/cooling mode.

- For **Comfort mode,** only de user setpoint (see section 2.3.1.2) is take into account:
  - ➢ The **Heating** mode gets triggered when the effective room temperature is equal or lower than the **user setpoint** minus Comfort lower band.
  - ➢ The **Cooling** mode gets triggered when the effective room temperature is equal or higher than the **user setpoint** plus Comfort upper band.

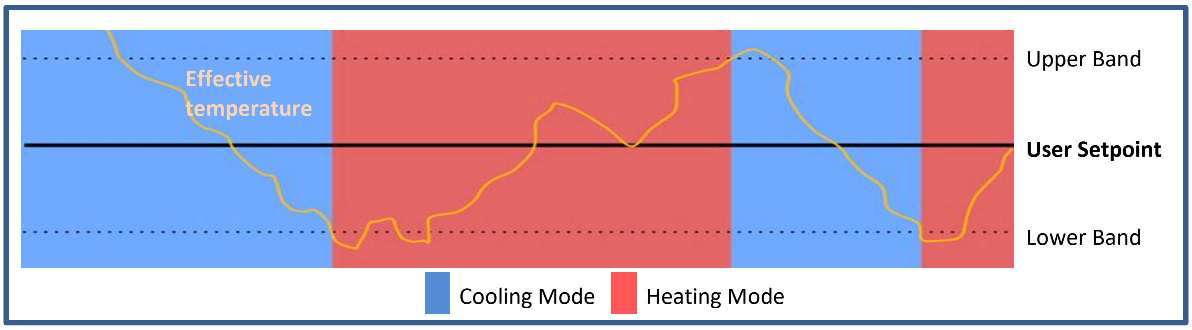


Figure 3. Automatic H/C Mode changeover

Note: *The user offset applied to the Comfort setpoint remains after an automatic mode change*.

The thermostat **will ignore any manual mode change command** until leaving comfort mode.

When enabling the automatic mode switch **only for Comfort**, the integrator will be given the possibility of parameterising whether the thermostat should maintain the operation mode (Heating / Cooling) unchanged **after leaving the Comfort special mode** (see section 2.3), or switch to the operation mode imposed by the system (i.e., by the room manager).

2.5 FAN CONTROL

The Hospitality thermostat brings the possibility of regulating the speed of the climate system fan by combining a manual and an automatic control:

- Under the Comfort special mode, the user will be able to switch between an **automatic control** and a **manual control** of the fan speed.
- Under any other special mode, the fan speed control will be **automatic**.

As for the user setpoint, when leaving the Comfort special mode, the status of the fan control mode (automatic or manual) and fan speed will be saved. This way, when the user returns to the room and returns to Comfort mode, the same control will be resumed.

The fan speed in an **automatic** control will depend on the current setpoint and the current room temperature, while in a **manual** control it will be the guest who sets the desired speed.

To switch between automatic and manual, a specific binary object will be provided. Therefore, unless this is set to manual, any percentage values received through the fan speed selection object will be ignored.

2.6 CONTROL METHODS

The room thermostatic control consists in sending the proper orders to the climate system, so the room ambient temperature reaches a certain (real) setpoint and then remains stable around that value.

The Hospitality thermostat offers two algorithms to perform such temperature control:

- **Two-Point Hysteresis Control**.
- **Proportional-Integral (PI) Control.**

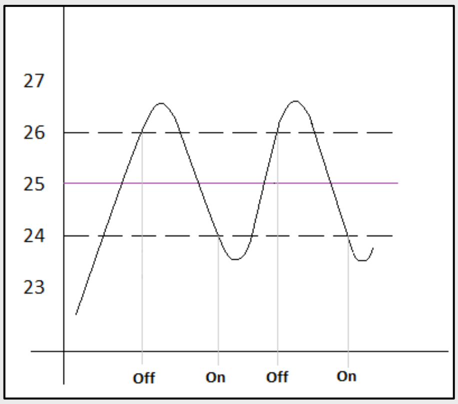
2.6.1 TWO-POINT HYSTERESIS CONTROL

Similar to the climate control performed by conventional thermostats, the basis of this algorithm consists in **commuting the control signal** between “on” and “off” depending on whether the room temperature has reached the setpoint or not.

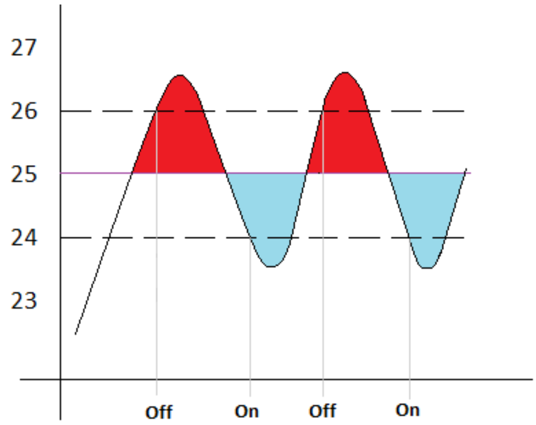
Indeed, apart from the **setpoint temperature**, two **values of hysteresis** (lower and upper) are required in order to define a clearance or margin around the setpoint, therefore preventing a continuous commutation between Heating and Cooling.

Example: *Two-Point Hysteresis.*

Suppose an initial real setpoint of 25ºC, with upper and lower hysteresis of 1ºC for the Heating mode, and an ambient temperature of 19ºC. The system heats the room until it *reaches 25ºC. It will continue heating until it becomes 26ºC, which is the upper limit of the hysteresis band. The climate system will then shut down, and will remain off until the ambient temperature is lower than 24ºC (not 25ºC), after which it will turn on again. This algorithm throws a very particular graph:*



The main disadvantage of this algorithm, when compared to other advanced systems, is the permanent fluctuation around the setpoint temperature, which has a direct impact on the power consumption and on the comfort:



The red colour sections correspond to periods of unnecessary power consumption, and of lack of comfort due to excessive heat. On the contrary, the blue colour sections indicate a lack of comfort due to insufficient heating.

Figure 4. Lack of Comfort.

The two-point hysteresis control will be restarted when any of the following occurs:

- The current operation mode (Cooling/Heating) changes.
- The current special mode changes.
- The real setpoint temperature changes.
- The thermostat is switched on.
- The device is restarted.

2.6.2 PROPORTIONAL-INTEGRAL (PI) CONTROL

It is a lineal control algorithm based not only on the difference between the setpoint and the reference, but also on the history of the system.

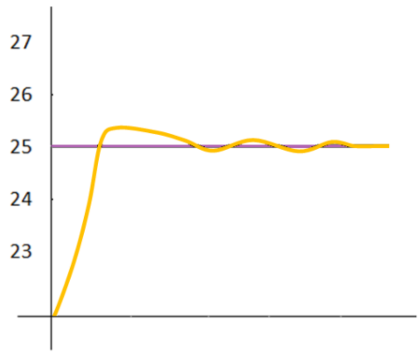


Figure 5. Proportional-Integral Control.

In addition, the control signals sent are not strict open/close orders, but intermediate orders. This reduces the temperature oscillation and the non-comfort sections of the previous algorithm, making the ambient temperature become progressively stable around the setpoint.

This algorithm requires configuring three main parameters:

- **Proportional Constant (K)**: expressed in terms of degrees, estimates an error value proportional to the difference between the real setpoint and the reference temperature.
- **Integral Time (T)**: expressed in minutes, this constant depends on the thermal inertia of the climate system, and makes it possible to adjust the approximation error depending on the elapsed time.
- **PI Cycle Time**: expressed in minutes or seconds, this cycle time is taken into account for setting the temperature sampling frequency and therefore the update frequency of the control signal being sent.

Although the Zennio devices let expert users manually set custom values for the above parameters, it is advisable to make use of one of the pre-set options, which should fit the most common climate situations (see ANNEX I: Pre-set Values for the PI Control).

Regarding the control signals of the PI mode, they can be expressed in two forms:

- **Continuous PI**: the control variable will throw **percentage values**, thus indicating *how much* the valve (or grille) that regulates the climate system should open. For instance, a value of 50% will indicate that valve must remain half open. Of course, this method only applies to advanced systems, where the valves accept intermediate positions.

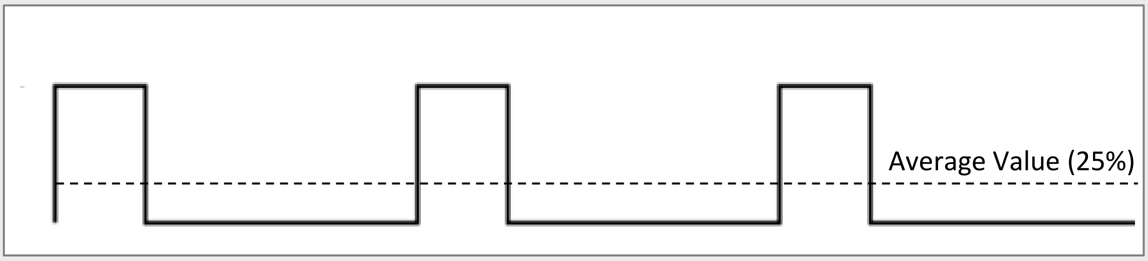
- **PWM (Pulse Width Modulation)**: the control variable will be **binary**, being this way possible to control "on/off" valves with no intermediate positions. Partial opening of the valve (for example: at 50%) is therefore emulated by successively opening/closing it (entirely) for similar time portions.

- To prevent repeatedly opening and closing the valves, it is possible to define a **minimum PWM signal commutation time**. In addition, it is possible to specify what to do in case a **PWM time lower than the minimum time** is required: commuting the control signal (applying the minimum time) or ignoring the commutation.

  Note: *for a proper behaviour of this kind of control, it is necessary that the PI cycle time is at least twice the minimum PWM commutation time*.

Example: *PI control with PWM.*

Let a "continuous PI" thermostat control system determines a control variable of 25%, which will be interpreted by intermediate-positioning valves as an order to open at 25%. The equivalent PWM variable for that would be a binary signal that remains at high level (value "1") for 25% the configured PI cycle time, and at low level (value "0") during the remaining 75% of the cycle time. Therefore, an on/off valve will stay entirely open 25% of the time, and entirely closed 75% of the time.



On the other hand, under situations of control signal saturation, during which the variable becomes 100% due to drastic differences between the setpoint and the reference temperature, a significant integral error will accumulate as the time passes, so once the setpoint is reached, the system will still send a positive signal because of the influence of the system history in the PI algorithm.

This will cause an excessive heat/cool supply, which will take some time to be compensated. To prevent these situations, there are two strategies to **reset the accumulated error**:

- As soon as the setpoint is reached after a signal saturation or, in other words, once the control signal is saturated, it will remain at 100% until the setpoint temperature is reached. At that moment, without waiting for the cycle time to expire, the PI control is completely restarted, thus sending the new calculated value of the control signal (which will be 0%).
- When the setpoint temperature is modified.

Note: *This is the strategy followed by default but it can be disable in the "Advanced" option in the PI Control parameters (see section 3.1.7.2)*

The following figures show the effect on the ambient temperature depending on whether the reset of the accumulated integral error is enabled or not:

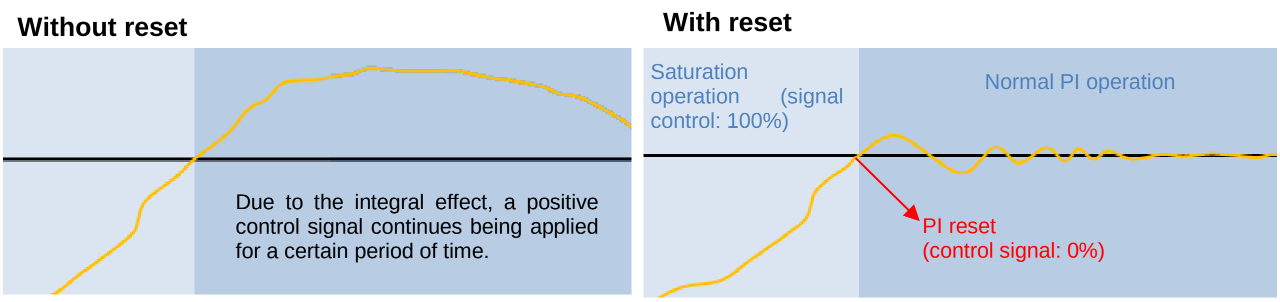


Figure 6. Effect of Resetting the Accumulated Integral Error after Signal Saturation.

2.6.3 CONTROL UNDER THE 'PROTECTION' SPECIAL MODE

With independence of the parameterised control type (two-point hysteresis or PI), under the **Protection special mode** a variant of the two-point control algorithm will be applied, with the following hysteresis values:

- For the **Heating** mode: lower hysteresis of 0ºC and **upper hysteresis of 1ºC**.
- For the **Cooling** mode: **lower hysteresis of 1ºC** and upper hysteresis of 0ºC.

The **outputs** will behave as on / off: if a two-point control was configured, the output variable will take the values 0 and 1, while in the PI control it will still consist in 0s (0%) and 1s (100%), but sent periodically.

Example: *Control under the Protection mode.*

Suppose a setpoint for the Building Protection special mode of 7ºC and 35ºC for Heating and Cooling, respectively, and a PI control with a percentage-type signal.

Case 1: *while in the Heating mode, a control signal of 100% will be sent as soon as the reference temperature reaches 7ºC, and of 0% as soon as it is 8ºC or more.*

Case 2: *while in the Cooling mode, a control signal of 100% will be sent as soon as the reference temperature reaches 35ºC, and of 0% as soon as it is 34ºC or less.*

2.7 ADDITIONAL COOLING / HEATING

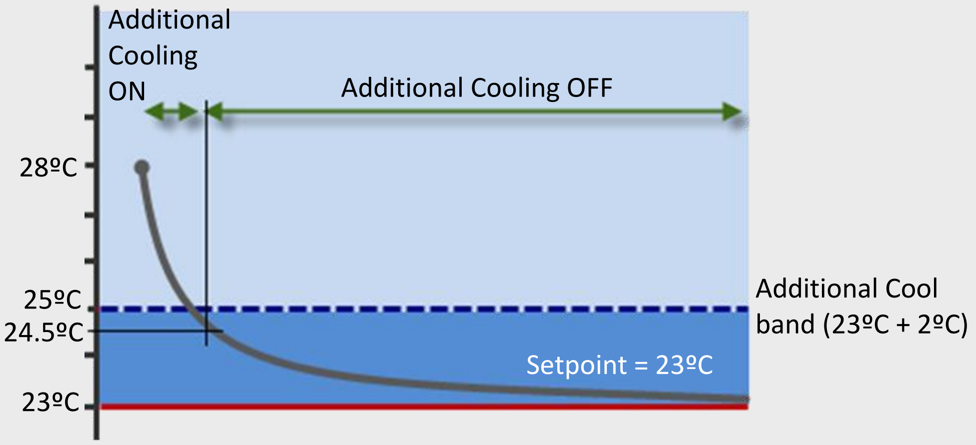
The Hospitality thermostat is capable of **controlling secondary heat/cool sources** (air-conditioning devices, heat pumps, etc.), in case they are available. This way, it is possible to perform an even more effective thermostatic control by combining multiple climate systems for the same purpose, which will report a higher comfort level.

As an example of this function, think of a room where the primary climate system is a radiant floor system (which is known to have a high thermal inertia and a moderately slow response after setpoint changes) and a split air conditioner working as a support system, being the latter capable of a faster response upon significant setpoint changes.

To configure the Additional Cooling / Heating function, it is necessary to define a certain **temperature range** (or band) that will determine when the auxiliary system should come into operation. Once defined, the behaviour is as follows:

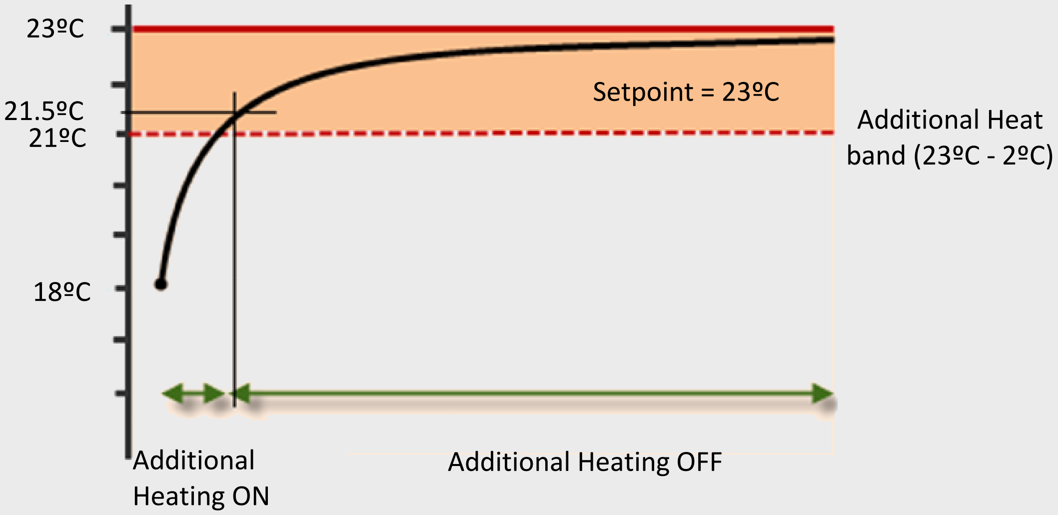
- **Cooling Mode**: as soon as the reference temperature is found to be **greater or equal** than T_1 (being T_1 equal to the setpoint temperature plus the Additional Cool band), the auxiliary cool system will come into operation to provide a more effective cooling. Then it will switch off once the reference temperature is lower or equal than T_1 – 0.5ºC.

> ***Example***: *Additional Cooling.*
>
> *Suppose a setpoint temperature of 23ºC and an Additional Cool band of 2ºC. In such case, the additional cooling will interrupt at 24.5ºC.*



- **Heating Mode**: as soon as the reference temperature is found to be **lower or equal** than T_2 (being T_2 the setpoint temperature minus the Additional Heat band), the auxiliary heat system will come into operation to provide a more effective heating. Then it will switch off once the reference temperature is greater or equal than T_2 + 0.5ºC.

> ***Example***: *Additional Heating.*
>
> *Suppose a setpoint of 23ºC and an Additional Heat band of 2ºC. In such case, the additional heating will interrupt at 21.5ºC.(See figure in the next page).*



2.8 DEHUMIDIFICATION

Besides the thermostatic control, the Hospitality thermostat can dehumidify the room, provided the following conditions are met:

- Air conditioning system must be a **fan coil**.
- **Cooling mode**: dehumidification will use the condensation produced in the fan coil tubes when very cold water circulates through them.
- **Relative humidity** values above the defined limit. If the humidity is above this limit, the **alarm** will be activated and sent periodically to the bus.
- **Temperature of the room** must be **between the setpoint and the lower temperature hysteresis** to dehumidify. The operating range is limited to prevent dehumidification from lowering the room temperature excessively.

Once the above conditions are met, dehumidification will be activated, notifying it by object. The control variable will be forced to the maximum value and the fan, in manual mode, to the speed chosen by parameter, which **is recommended to be as low as possible**. This will help maximize the condensation in the pipes for the effectively removal ambient humidity.

Dehumidification will stop as soon as any of the conditions are no longer met, either because the relative humidity is lower than the limit minus its hysteresis or because the temperature is outside the range.

If dehumidification is deactivated by lowering the temperature below the hysteresis, there will be a return hysteresis, so that the control is not switched on immediately when the temperature rises again, preventing the control from switching off and on consecutively and the energy consumption involved. Figure 7 shows a graphic example:

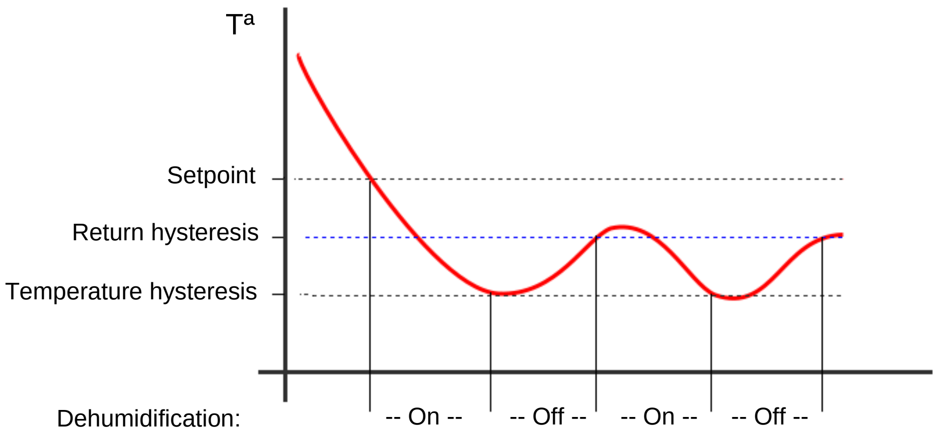


Figure 7 Dehumidification. Return hysteresis.

Each special mode will have his own temperature hysteresis. In comfort mode you can also decide whether or not to apply the control when the room is occupied.

Notes:

- *If the temperature hysteresis of a special mode is 0, in this mode the dehumidification will be considered deactivated*.
- *Dehumidification will be available even if the thermostat is set to heating only, so that apparent temperatures can be used and the high humidity alarm is available.*

2.9 SCENE MANAGEMENT

The Hospitality thermostat offers the possibility of managing up to **five different scenes**, each of which can trigger a particular thermostat action whenever its particular scene number is received from the bus. Optionally, the integrator can enable the possibility of **recording** (saving) scenes.

The available actions, which are not mutually exclusive and which can be enabled (or not) and configured for each scene, are:

- **Switch-on / Switch-off**:

  If the thermostat has been configured not to be always on, the **execution** of the scene can be parameterised to cause a switch-on (On) or a switch-off (Off) of the thermostat.

In case an order is received to **save** the scene, the parameterised value will be overwritten with the current on/off state of the thermostat, unless No change has been parameterised.

- **Mode (Cooling / Heating)**:

  On the **execution** of the scene, the thermostat will switch to the desired operation mode (Cooling / Heating / No change), which should be set in parameters.

  In case of **saving** the scene, the value parameterised will be overwritten with the current value of the status object, unless No change has been parameterised.

  Note: *if the thermostat has been configured for only heating or only cooling, this option will not be available*.

  Important: *the mode is changed in the status object "[HTx] [A] Mode Status", not in the control object. Under no circumstances the system mode will be changed.*

- **Special Mode**:

  The **execution** of the scene can also trigger a certain **special mode**: Comfort, Standby, Economy, Protection or No change.

  In case of **saving** the scene, the above value will be overwritten with that of the current special mode, unless No change has been parameterised.

Example: *Executing and Running Thermostat Scenes.*

Suppose the first scene is assigned number 32, and an action consisting in a switch-on of the thermostat and the activation of the Comfort special mode, leaving the H/C mode as is. The option of saving scenes is also enabled.

- ***Case 1***: *being the thermostat on and under the Cooling and Standby modes, when the order to execute the scene arrives (bus value "31") it will switch to Comfort.*
- ***Case 2***: *being the thermostat off, when the order to execute the scene arrives, it will switch on and change to Comfort, remaining in the Heating/Cooling mode it already had before having been switched off.*
- ***Case 3***: *being the thermostat off and being Heating and Economy the last active modes, an order to save the scene (bus value "159") arrives. Scene with number*

32 gets therefore updated with the current state of the thermostat – it will now consist in switching the thermostat off and triggering the Economy special mode (note that the Cooling/Heating operation mode is not saved due to the original parameterisation). Afterwards, being the thermostat on and under the Cooling and Comfort modes, if the scene execution order is received (bus value "31"), it will switch off and activate the Economy special mode (leaving the operation mode in Cooling), according to what was saved.

2.10 ECO MODE

This functionality allows the room manager monitoring the ratio of the room occupation time during which **the real setpoint** (see section 2.3.1.2) **fell within the ecological limits**, according to the criterion of the room manager. This can be useful, for example, to reward or encourage eco-friendly guests.

To use this function, it is necessary to define (in parameters or via bus objects) the eco range for the setpoints under **Cooling** and under **Heating** (i.e., a lower setpoint limit for the Cooling mode and an upper setpoint limit for the Heating mode).

- <u>Occupied room, thermostat in Comfort mode and real setpoint within the ecological range</u> ➔ **Eco performance**.
- <u>Occupied room, thermostat not in Comfort mode</u> ➔ **Eco performance**.
- <u>Occupied room, thermostat in Comfort mode but user setpoint outside the ecological range</u> ➔ **Non-Eco performance**.

A **binary object** will be sent whenever the room switches from Eco to Non-Eco (value "0") or from Non-Eco to Eco (value "1").

<u>**Note**</u>: *To ensure that this object reading returns consistent values, taking it while the room is occupied and in Comfort mode is advisable.*

In addition to the binary object, the thermostat provides the room manager a one-byte object which returns the **percentage of the eco-performance time** in relation to the total occupation time of the room, since it was sold. This object is transmitted to the bus whenever its value changes, with a **minimum time space of ten minutes** between two consecutive transmissions.

3 ETS PARAMETERISATION

3.1 DEFAULT CONFIGURATION

The configuration process begins by entering the *Parameters* tab of the device. Depending on the Zennio device, several Hospitality thermostats may be available for parameterisation, as the figure shows.

Figure 8. Enabling the Hospitality Thermostat.

For details on how to enable the available thermostats, please consult the specific user manual of the device.

Once the thermostat is enabled, the tab tree on the left will include a set of tabs for the configuration of the related parameters.

Note: *for the convenience of the integrator and due to the large amount of communication objects, the name of most of the parameter screens has been labelled with a capital letter ("A", "B", "C", …), and so have been the names of the communication objects, depending on the parameter screen their functionality refers to*.

3.1.1 "[A] CONFIGURATION" TAB

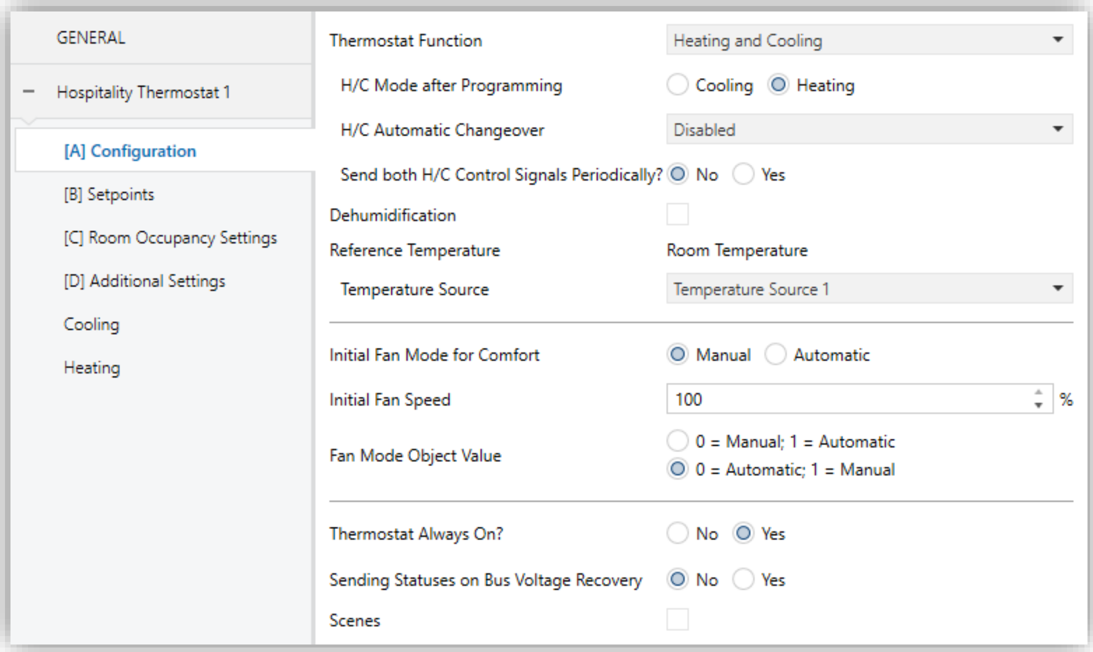


Figure 9. Configuration.

- **Thermostat Function** [*Heating / Cooling / Heating and Cooling*][1]: defines the main working modes that will be available. Depending on the selection, tabs "Heating" and "Cooling" will be shown in the tab list on the left. Please refer to sections 3.1.6 and 3.1.8 for details on their parameterisation.

  If the two modes have been enabled, additional parameters will be displayed:

  - **H/C Mode After Programming** [*Cooling / Heating*]: sets whether the thermostat should start up in the Heating mode or in the Cooling mode, right after an ETS download.

  - **H/C Automatic Changeover**: grants or not the thermostat the responsibility of automatically switching from one operation mode to the other one (Heating / Cooling) depending on the effective reference temperature and the setpoint. See section 2.4.2.

[1] The default values of each parameter will be highlighted in blue in this document, as follows: [*default/rest of options*].

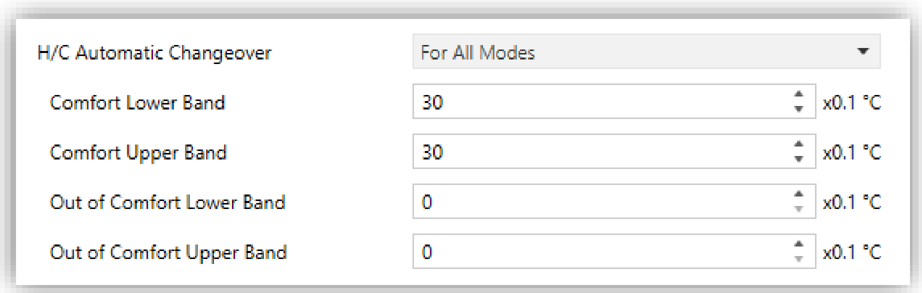


Figure 10. Configuration – H/C Automatic Changeover

- [*Disabled*]. When this option is selected, the binary object "**[HTx] [A] User Mode**" will appear additionally, allowing to monitor and manage the manual mode switching ("0" will switch to "Cooling", while "1" will switch to "Heating").

- [*For Comfort*]. The following parameters will be shown:

  - **Comfort Lower / Upper Band** [*0…30…255*] [*x0,1 ºC*]: clearance bands around setpoint temperature.

  - **Mode After Exiting Comfort** [*Stay in the same H/C Mode / Change to the system H/C Mode*]: sets whether the active operation mode (after leaving the Comfort special mode) should remain as is until a mode switch order arrives, or automatically switch to the current mode of the room managing system.

- [*For All Modes*]. The following bands will be set:

  - **Comfort Lower/Upper Band** [*0…30…255*] [*x0,1 ºC*].

  - **Out of Comfort Lower/Upper Band** [*0…255*] [*x0,1 ºC*]: band around the heating/cooling setpoints. This band will be common to all special modes other than comfort.

Irrespective of the option chosen for **automatic changeover**, the current mode can be consulted by reading the object value "**[HTx] [A] Mode Status**" and knowing and switching the system mode through the object "**[HTx] [A] System Mode**".

➢ **Send Both H/C Control Signals Periodically?** [*No / Yes*]: sets whether to send periodically the control variables of both, the Heating and the Cooling modes (and, if enabled, the Additional Heat and Additional Cool objects; see sections 3.1.8 and 3.1.8), or whether to send only the variable of the currently active mode. Note that the control variable of the currently inactive mode will be zero.

The sending period should be configured for each mode (Heating/Cooling) from its specific parameter tab.

Additionally, there will be a binary object named "**[HTx] [A] On/Off Fancoil**", which will acquire a value of "1" whenever there is a demand according to the control signals (provided that the thermostat itself is on and the current special mode is Comfort) or a value of "0" in another case.

- **Dehumidification** [*disabled/enabled*]: enables the Dehumidification function, the parameter tab named [F] Dehumidification and his objects: "**[HTx] [F] Current Humidity**", "**[HTx] [F] High Humidity Alarm Threshold**", "**[HTx] [F] Dehumidification Control**", "**[HTx] [F] Dehumidification Status**", "**[HTx] [F] High Humidity**" and "**[HTx] [F] Enable Apparent Temperature**". See section 3.1.6 for details.

- **Reference Temperature** [*Room Temperature / Apparent Temperature*]: select which reference temperature will be used for the calculations of the dehumidification control. This temperature will be sent through the object **[HTx] [A] Room Temperature**. It is possible to select the temperature for calculations on runtime through the object "**[HTx] [F] Enable Apparent Temperature**".

  Note: *"Apparent temperature" can only be selected if the dehumidification function is enabled.*

  - **Temperature Source** [*Temperature Source 1 / Proportion [75%(1) – 25%(2)] / Proportion [50%(1) – 50%(2)] / Proportion [25%(1) – 75%(2)] / Temperature Source 2*]: determines the source of the reference temperature. This may be the value of a sole two-byte communication object ("**[HTx] [A] Temperature Source 1**"), or a combination of two two-byte objects ("**[HTx] [A] Temperature Source 1**" and "**[HTx] [A] Temperature Source 2**") with a configurable proportion.

If apparent temperature is selected (see section 3.1.6), the value of the temperature chosen in this parameter will be calculated together with the humidity (as explained in section 2.2.2).

The reference temperature will be sent to the bus every time that the thermostat receives a new value of temperature (or humidity, if the apparent temperature is used as a reference).

- **Initial Fan Mode for Comfort** [*Manual / Automatic*]: determines whether the fan control should be manual or automatic after entering the Comfort special mode for the first time. Under any other special mode, the fan control will remain automatic.

  - **Initial Fan Speed** [*0%…100%*]: in case the above parameter has been set to "Manual", this parameter will let setting the desired initial fan speed, in terms of percentage. The current fan speed can be afterwards changed through the "**[HTx] [A] Fan Speed**" one-byte object.

- **Fan Mode Object Value** [*0 = Manual; 1 = Automatic / 0 = Automatic; 1 = Manual*]: sets the polarity of the fan mode object ("**[HTx] [A] Fan: Manual/Automatic**").

- **Thermostat Always On?** [*No / Yes*]: sets whether the thermostat should remain always on ("Yes") or, on the contrary, whether it should be possible to turn it on / off externally ("No").

  In the second case, two new binary communication objects ("**[HTx] [A] On/Off**" and "**[HTx] [A] On/Off Status**") will show in ETS, as well as the following parameters:

  - **Startup Setting (On Bus Voltage Recovery)** [*Last (Before Bus Failure) / OFF / ON*]: sets the start-up state of the thermostat (after a power failure or an ETS download. "Last" will be considered as "Off" on the very first start-up (after a download).

- **Sending Statuses on Bus Voltage Recovery** [*No / Yes*]: sets whether the device should send the KNX bus the thermostat and fan-coil status objects after the start-up. Sending their updated value is also possible after a certain delay after the start-up, defined through the parameter **Sending Delay** [*0…255*] [*s*].

Note: *In case of enabling and to ensure the sending of all the statuses associated with all available thermostats, to set a minimum delay of 2 seconds for each thermostat is advisable. For example, whether 10 thermostats are available, the recommended minimum delay would be 20 seconds.*

- **Scenes** [disabled/enabled]: enables the Scenes function of the thermostat, and therefore the corresponding specific tab in the menu on the left (see section 2.9) and the "**[HTx] [A] Scene Input**" object, intended for the reception of scene commands from the KNX bus.

  Note: *the "**[HTx] [A] Scene Input**" object will show as long as the Scenes function has been enabled either from this parameter or from the "**[C] Room Occupancy Settings**" tab (see section 3.1.3), as the same object serves to both purposes*.

3.1.2 "[B] SETPOINTS" TAB

Depending on the **thermostat function** set in the "[A] Configuration" tab, the view of the following window may change, showing the Heating and/or Cooling setpoints:

Note: *the figures shown next contain parameters related to both, the Heating and the Cooling modes. If only one of the two modes has been enabled, ETS will hide the parameters of the other mode*.

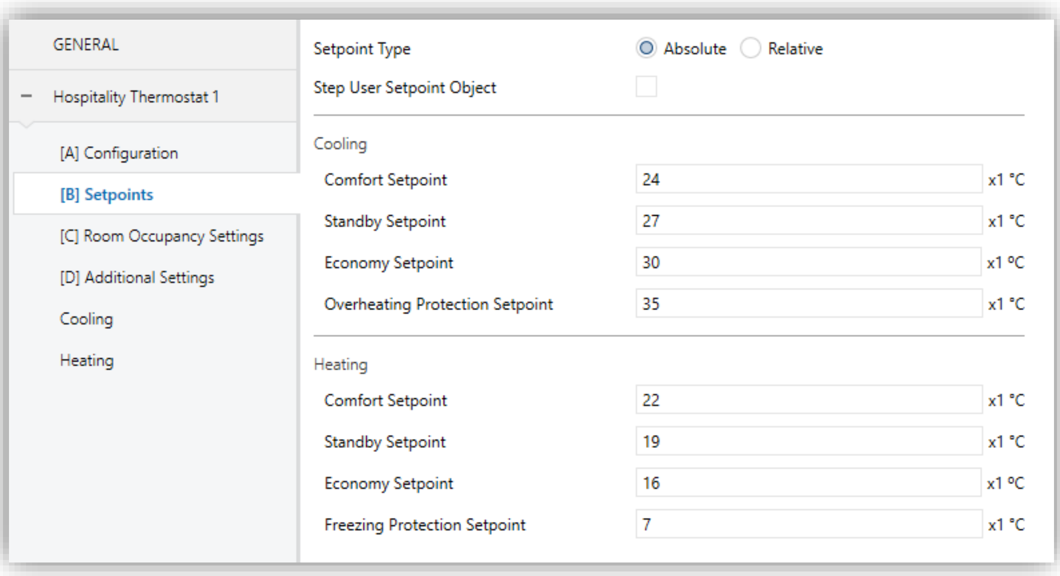


Figure 11. Setpoints.

The parameters shown in screen tab are:

- **Setpoint Type** [*Absolute / Relative*]: sets the type of control the user will perform over the setpoint in comfort mode.

  - [*Absolute*]: the user sets the desired temperature value for the room through the object "**[HTx] [B] User Setpoint Control (Cooling and Heating)**". The status object "**[HTx] [B] User Setpoint (Status)**" is also enabled.

  - [*Relative*]: the user sets an offset applied to the basic comfort setpoint (which the user will not normally know) through the object "**[HTx] [B] User Setpoint Offset (Cooling and Heating)**". The status object "**[HTx] [B] User Setpoint Offset (Status)**" is also enabled.

- **Step User Setpoint Object** [*disabled/enabled*]: enables the object "**[HTx] [B] Step User Setpoint**" which can be used to step control the user setpoint.

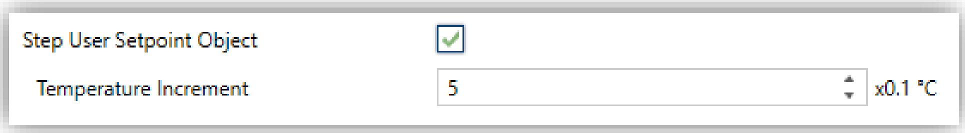


Figure 12. Step User Setpoint Control

  - **Temperature Increment** [*1…5…100*] [*x0,1 ºC*]: sets the decrement/ increment that will be applied to the setpoint when the value '0' or '1' is received through the object "**[HTx] [B] Step User Setpoint** ".

  It is possible to obtain the current user setpoint by reading the object "**[HTx] [B] User Setpoint Status**". Note that the value of this object may be conditioned by the **hidden offset** or the **setpoint constraints**, if any (see section 3.1.4). To obtain the *effective* setpoint value it is possible to read the object "**[HTx] [B] Real Setpoint Status**". Observe that both objects are automatically sent to the KNX bus when their value changes.

- **Comfort Setpoint** [*-20…100*] [*x1 ºC*]: defines the Comfort setpoints that will be applied after downloading. Default values are : Cooling [*24ºC*] and Heating mode [*22ºC*].

Note that both, the **user** and the **system** Comfort setpoints (see section 2.3.1) will initially match and be equal to the value of this parameter. However the system setpoints can also be modified independtly through specific bus objects:

- "**[HTx] [B] Comfort Setpoint (Cooling)**" and "**[HTx] [B] Comfort Setpoint (Heating)**".

If the option "For Comfor" or "For All Modes" is choosen for the parameter **H/C Automatic Changeover** (see section 3.1.1) and **Setpoint Type** is "Relative", the base of the confort setpoint will be the same for cold and heat mode (default value: *24ºC*). This value can be changed throught the following object:

- "**[HTx] [B] Comfort Setpoint**"

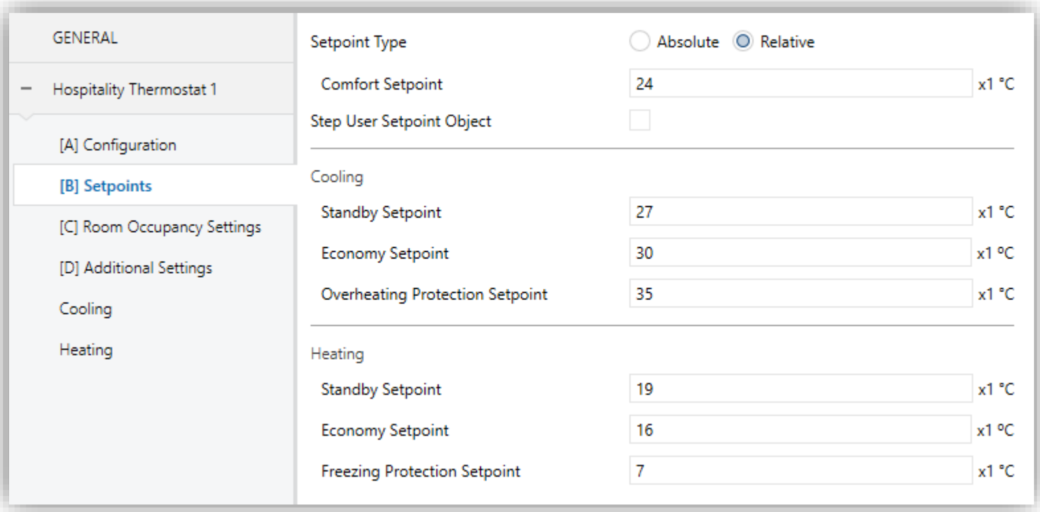


Figure 13. Relative Setpoints with H/C Automatic Changeover

The user setpoint and the mode can be reset (i.e., it will be assigned the system mode and the value of the system Comfort setpoint) at any time by sending one "1" to object "**[HTx] [B] User Comfort Setpoint Reset**".

- **Standby Setpoint** [*-20…100*] [*x1 ºC*]: defines the initial values of the Standby setpoints that will be applied after downloading. Default values are Cooling [*27ºC*] and Heating mode [*19ºC*].

  The setpoint of the Standby special mode can be modified through specific bus objects:

- "**[HTx] [B] Standby Setpoint (Cooling)**" and "**[HTx] [B] Standby Setpoint (Heating)**".

- **Economy Setpoint** [*-20…100*] [*x1 ºC*]: defines the initial values of the Economy setpoints that will be applied after downloading. Default values are [*30ºC*] for Cooling and [*16ºC*] for Heating mode.

  The setpoint of the Economy special mode can be modified through specific bus objects:

  - "**[HTx] [B] Economy Setpoint (Cooling)**" and "**[HTx] [B] Economy Setpoint (Heating)**".

- **Overheating Protection Setpoint** or **Freezing Protection Setpoint** [*-20…100*] [*x1 ºC*]: defines the Protection setpoints that will be applied after programming. Default values are [*35ºC*] for Cooling and [*7ºC*] for Heating mode.

  The setpoint of the Protection special mode can be modified through specific bus objects:

  - "**[HTx] [B] Protection Setpoint (Cooling)**" and "**[HTx] [B] Protection Setpoint (Heating)**".

3.1.3 "[C] ROOM OCCUPANCY SETTINGS" TAB

The parameters included in this screen are related to the occupancy states of the room, and the special-mode transitions derived from them.

This screen contains the following parameters:

- **Scenes** [*disabled/enabled*]: enables the room occupancy management through scenes. When the box is checked, the "**[HTx] [A] Scene Input**" object is added to the project topology, and the following parameters are shown:

  - **Day Occupation (0 = Disabled)** [*0/1…64*]: defines the scene number that is expected to arrive from the presence detector when the room changes from Unoccupied to Occupied (see section 2.3.2.2) during the day.

Entering the value "0" disables the activation of the day occupation state through the scene object.

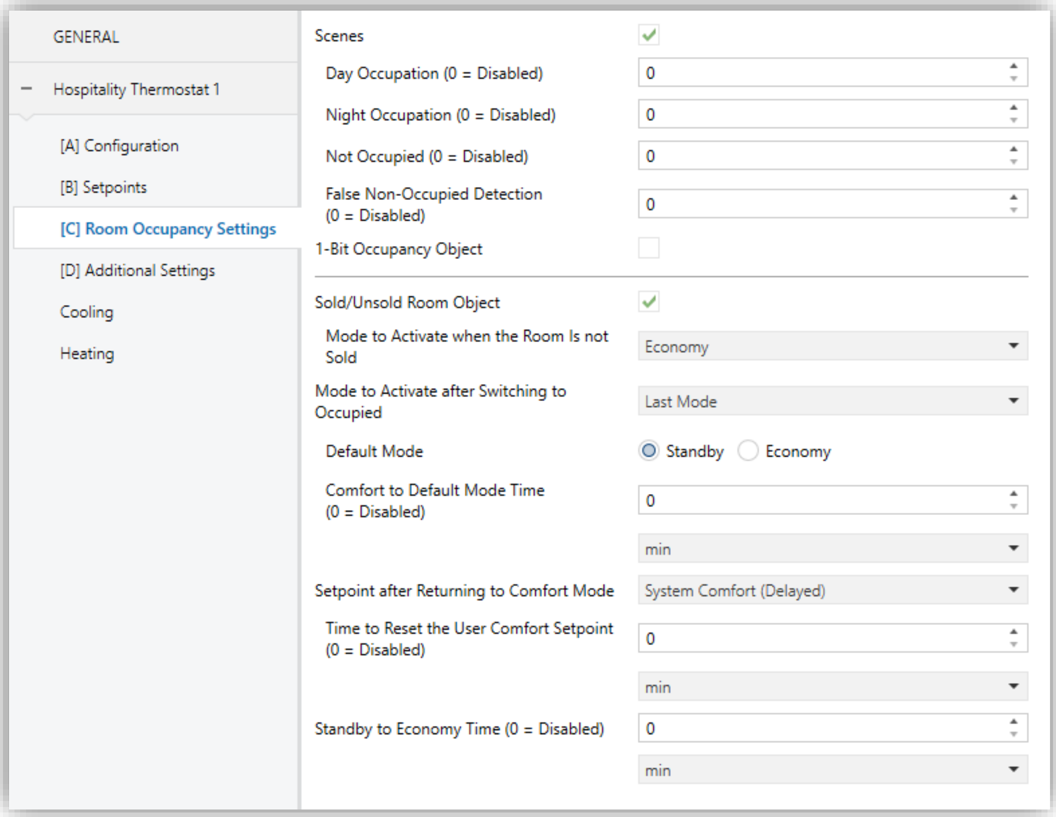


Figure 14. Occupancy settings.

- **Night Occupation (0 = Disabled)** [0/1…64]: defines the scene number that is expected to arrive from the presence detector when the room changes from Unoccupied to Occupied (see section 2.3.2.2) during the night. Entering the value "0" disables the activation of the night occupation state through the scene object.

- **Not Occupied (0 = Disabled)** [0/1…64]: analogous to the above parameter, but related to the transition from Occupied to Unoccupied.

- **False Non-Occupied Detection (0 = Disabled)** [0/1…64]: defines the scene number that is expected to arrive from the presence detector when a false transition from Occupied to Unoccupied takes place. Such option is available in some Zennio devices with motion detection capabilities (please refer to their specific user manual). Entering the value "0" disables the recognition of false Unoccupied detections through the scene object.

Note: *the "**[HTx] [A] Scene Input**" will show as long as scenes have been enabled from this parameter or from the "[A] Configuration" (3.1.1), as the same object serves to both purposes*.

- **1-bit Occupancy Object** [*disabled/enabled*]: enables the room occupancy management through the one-bit object "**[HTx] [C] Presence Detector (Input)**", which should receive the value "1" from the presence detector when the room changes to occupied, and the value "0" when it changes to unoccupied. It also enables the object **"[HTx] [C] Lock Presence Detection**" to maintain the room occupied without regarding what detectors send. See section 2.3.2.2.

  - **Value to Lock Occupancy Object** [*0 = Locked; 1 = Unlocked / 0 = Unlocked; 1 = Locked*]: sets the polarity of the object **"[HTx] [C] Lock Presence Detection**"

- **Sold/Unsold Room Object** [*disabled/enabled*]: enables the "**[HTx] [C] Sold/Unsold Room (input)**" binary object, which should receive the value "1" from the room managing system when the room becomes sold, and the value "0" when it becomes unsold. See section 2.3.2.2.

  - **Mode to Active when the Room Is not Sold** [*Comfort / Standby / Economy*]: special mode that will be trigger when the room state switches from sold to unsold.

- **Mode to Activate after Switching to Occupied** [*Last Mode / Comfort / Standby / Economy*]: selects the special mode that will be triggered by the thermostat when the room state switches to occupied (see section 2.3.2.2).

  In case of choosing the latter, two new parameters will be shown:

  - **Default Mode** [*Standby/Economy*]: sets the default special mode that will be triggered in case the last mode was other than Comfort (see section 2.3.2.2).

  - **Comfort to Default Mode (0 = Disabled)** [*0/1…255*][*s/min/h*]: sets a timeout so, in case the room remains unoccupied for more than such time, the special mode that will be triggered once occupied again will be the default mode, even if the last mode was Comfort (see section 2.3.2.2). The value "0" disables the function.

Note: *this value can be overwritten through the "**[HTx] [C] Transition Time: Comfort to Default Mode**" two-byte object.*

- **Setpoint after Returning to Comfort Mode**: defines the setpoint the thermostat will apply whenever it triggers the Comfort mode due to the room being occupied again:

  - [User Comfort]: i.e., the user Comfort setpoint,
  - [System Comfort]: i.e., the system Comfort setpoint,
  - [System Comfort (Delayed)], i.e., the user Comfort setpoint, unless the room remains unoccupied for a significant amount of time (in such case, the system Comfort setpoint will be applied). See section 2.3.2.2.

  In case of choosing the latter, a new parameter will allow defining such delay:

  - **Time to Reset the User Comfort (0 = Disabled)** [0/1…255] [s/min/h]. The value "0" disables the function.

  Notes:

  - *This reset will only be applied when leaving comfort mode by detecting not occupation in the room, i.e., the reset will not be applied when the special mode has been switched manually.*
  - *This value can be overwritten through the "**[HTx] [C] Time to Reset the User Comfort**" two-byte object.*

  These parameters only apply in case of returning to Comfort as a consequence of an Unoccupied to Occupied transition. Special-mode switches while occupied do not involve a reset of the user setpoint.

  On the other hand, if such transition triggers a special mode other than Comfort, and afterwards the guest switches to Comfort, the user setpoint will still remain as it was before the room became unoccupied.

- **Standby to Economy Time (0 = Disabled)** [0/1…255] [s/min/h]: defines a timeout after the room became Unoccupied to switch the special mode from Standby to Economy. A value of "0" disables this function.

Note: *this value can be overwritten through the “**[HTx] [C] Transition Time: Standby to Economy**” two-byte object.*

3.1.4 “[D] ADDITIONAL SETTINGS” TAB

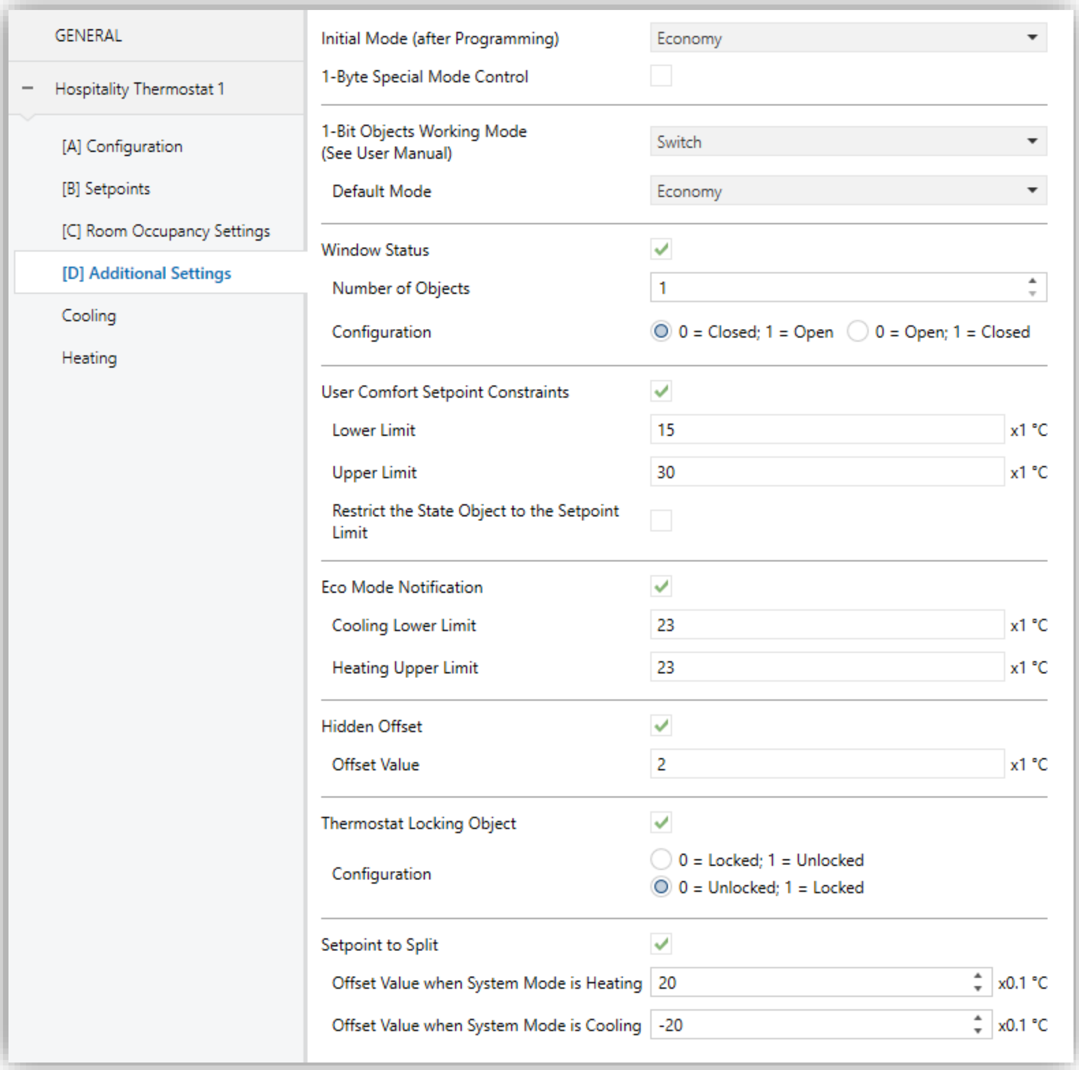


Figure 15. Additional Settings.

The parameters shown in this tab are:

- **Initial Mode (after Programming)** [*Comfort / Standby / Economy*]: defines the special mode to be activated after a download.

- **1-Byte Special Mode Control** [*disabled/enabled*]: enables the “**[HTx] [D] Special Mode**” one-byte object, which permits activating the different special modes by writing the appropriate values on it:

Value	Mode
1	Comfort
2	Standby
3	Economy
4	Protection

Table 2. Special Modes.

The currently active special mode can be obtained by reading the one-byte object "**[HTx] [D] Special Mode Status**". It is also possible to read the "**[HTx] [D] Comfort Mode Status**" one-bit object to know whether the current mode is Comfort ("1") or not ("0").

- **1-Bit Objects Working Mode** [*Trigger / Switch / Disabled*]: enables or disables the special mode selection one-bit objects.

  - "**[HTx] [D] Special Mode: Comfort**",
  - "**[HTx] [D] Special Mode: Standby**",
  - "**[HTx] [D] Special Mode: Economy**",
  - "**[HTx] [D] Special Mode: Protection**".

  The response type can be "Trigger" or "Switch" (see section 2.3.2.1).

  In case of opting for "Switch", an additional parameter will show up (**Default Mode** [*Comfort / Standby / Economy*]) for the selection of the special mode to be adopted by the thermostat when all the binary objects have the value "0". This option should not be confused with the selection of an initial mode for the thermostat, which is determined by the value of **Initial Mode (after Programming)**.

  In case of selecting "Disabled", switching the special mode will only be possible through the one-byte "**[HTx] [D] Special Mode**" object, if enabled.

- **Window Status** [*disabled/enabled*]: enables or disables the "**[HTx] [D] Window Status n (input)**" one-bit objects, which will make the thermostat switch to the Protection mode (see section 2.3.2.3) as soon as the open window value (0 or 1, according to the parameterisation) is received through one of them. Up to four window objects are available, depending on **Number of Objects**.

On the other hand, the one-bit object "**[HTx] [D] Enable Window Status**" permits interrupting ("0") and resuming ("1") the window status function. While interrupted, the incoming values will be ignored.

- **User Comfort Setpoint Constraints** [*disabled/enabled*]: sets an upper limit [*-20…15…100*] [*x1 ºC*] (for Heating) and a lower limit [*-20…30…100*] [*x1 ºC*] (for Cooling) for the user Comfort setpoint, so the effective setpoint does never reach excessively demanding values.

  Enabling the **Restrict the State Object to the Setpoint Limit** parameter will make this restriction invisible for the room guest, as the status object will not be truncated (see section 2.3.1.3).

  These constraints can be overwritten through objects **"[HTx] [D] Comfort Lower Limit**" and "**[HTx] [D] Comfort Upper Limit**".

- **Eco Mode Notification** [*disabled/enabled*]: enables or disables the Eco Mode function (see section 2.10), and the involved notifications.

  If enabled, the following parameters will be shown:

  - **Cooling Lower Limit** [*-20…23…100*] [*x1 ºC*]: sets the lowest setpoint temperature in degrees that will be admitted as "eco" while in the Cooling mode.
  - **Heating Upper Limit** [*-20…23…100*] [*x1 ºC*]: sets the highest setpoint temperature in degrees that will be admitted as "eco" while in the Heating mode.

  The above limits can be modified through objects:

  - "**[HTx] [D] Eco Mode: Lower Limit (Cooling)**",
  - "**[HTx] [D] Eco Mode: Upper Limit (Heating)**".

  The one-bit and one-byte notifications (see section 2.10) will be sent to the bus through objects "**[HTx] [D] Eco Mode Notification**" and "**[HTx] [D] Eco Mode Ratio**", respectively.

- **Hidden Offset** [*disabled/enabled*]: enables the implementation of a hidden offset over the user Comfort setpoint, resulting in a less energy-demanding effective setpoint (see section 2.3.1.2).

Object "**[HTx] [A] Room Temperature**" will also be applied the same offset, to preserve consistence from the guest's point of view.

If enabled, the following parameters will be shown:

- **Offset Value** [*-20…2…100*] [*x1 ºC*]: defines the offset value when it is activated.

The offset needs to be configured in parameters, although it can be modified through object "**[HTx] [D] Hidden Offset Value**", while its application can be interrupted or resumed through object "**[HTx] [D] Hidden Offset On/Off**".

- **Thermostat Locking Object** [*disabled/enabled*]: enables or disables the "**[HTx] [D] Thermostat Lock**" binary object (see section 2.3.2.3).

  The lock and unlock trigger values must be set through the **Configuration** parameter [*0 = Locked; 1 = Unlocked / 0 = Unlocked; 1 = Locked*]

- **Setpoint to Split** [*disabled/enabled*]: enables the object "**[HTx] [D] Setpoint to Split**". This object will be sent every time the real setpoint changes.

  When enabled, the offsets to apply over the especial modes different from comfort will be shown:

  - **Offset Setpoint when System Mode is Heating** [*-50…20…50*] [*x0.1 ºC*].
  - **Offset Setpoint when System Mode is Cooling** [*-50…-20…50*] [*x0.1 ºC*].

3.1.5 "[E] SCENES" TAB

After enabling "**Scenes**" in the "**Configuration**" screen, a new tab will be included into the menu on the left.

As shown in Figure 16, from this tab it is possible to independently enable up to five scenes, and to configure what actions should be taken over the different attributes of the thermostat when each of the scenes is triggered.

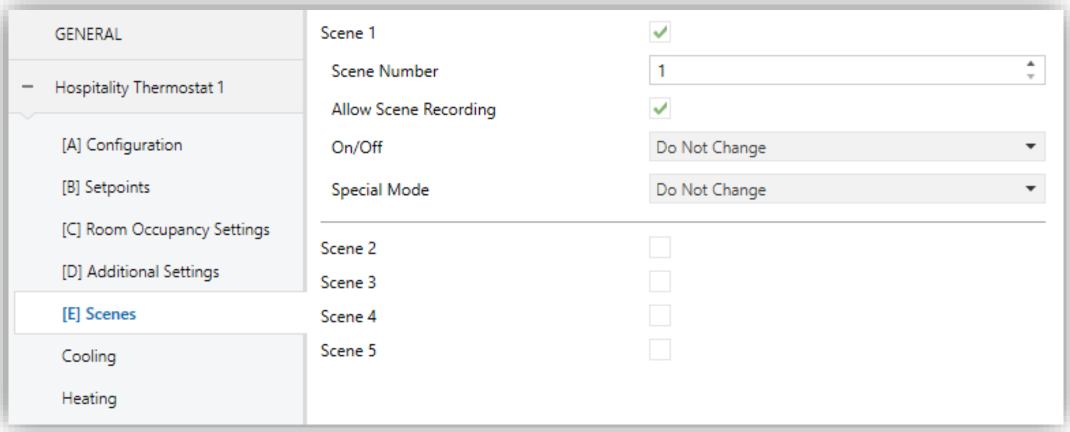


Figure 16. Scenes.

For each of the five scenes, the parameters are:

- **Scene Number** [*1…64*]: number of the scene the arrival of which (through "**[HTx] [A] Scene Input**", decremented by one according to the standard) will trigger the execution of the actions defined below.

- **Allow Scene Recording** [*disabled/enabled*]: if enabled, the reception of scene **save** commands (values between "128" and "191") will also be possible, being therefore possible to overwrite the configuration initially parameterised for the scene. See section 2.9 for details.

- **On / Off** [*Do Not Change / Off / On*]: sets the on/off state the thermostat will adopt upon the execution of the scene. In case the option "**Thermostat always ON**" (section 3.1.1) has been activated, this parameter will not be available.

  Note: *if this is set to "Do Not Change", the on/off state of the thermostat will be ignored when saving the scene. See section 2.9*.

- **H/C Mode** [*Do Not Change / Cooling / Heating*]: sets the general operation mode the thermostat will adopt upon the execution of the scene. In case the option "**H/C Automatic changeover**" (see section 3.1.1) has been activated, this parameter will not be available.

  Note: *if this is set to "Do Not Change", the general operation mode of the thermostat will be ignored when saving the scene. See section 2.9*.

Important: *the mode is changed in the status object "[HTx] [A] Mode Status", not in the control object.*

- **Special Mode** [Do Not Change / Comfort / Standby / Economy / Protection]: sets the specific special mode the thermostat will adopt upon the execution of the scene.

  Note: *if this is set to "Do Not Change", the current special mode or setpoint of the thermostat will be ignored when saving the scene. See section 2.9.*

3.1.6 "[F] DEHUMIDIFICATION" TAB

After enabling "**Dehumidification**" in the "**Configuration**" screen, a new tab will be included into the menu on the left.

This tab shows all the parameters available for configuring dehumidification.

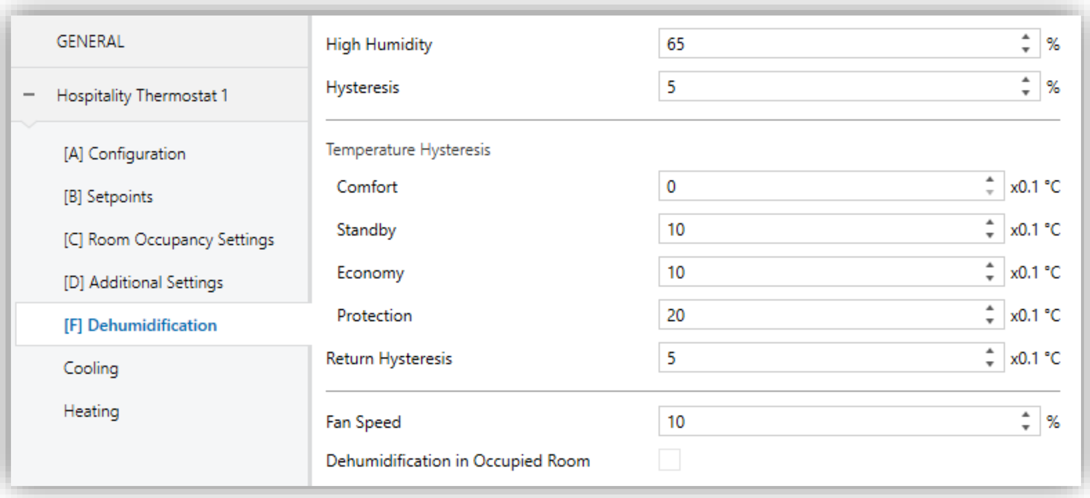


Figure 17. Dehumidification

The parameters of this tab are the following:

- **High Humidity** [0...65...100] [%]: Relative humidity limit value, above which the alarm will be activated and the object "**[HTx] [F] High Humidity**" is sent with value "1" value every 30 seconds. It is possible to change the limit value through the object "**[HTx] [F] High Humidity Alarm Threshold**".
- **Hysteresis** [1...5...25] [%]: Lower humidity hysteresis. When the humidity becomes lower than the high humidity limit minus this hysteresis, the alarm is deactivated and the object "**[HTx] [F] High Humidity**" is sent with value "0".

- **Temperature Hysteresis** [*0…200*] [*x0,1ºC*]: lower temperature setpoint hysteresis. When the temperature (room or apparent) becomes lower than the setpoint minus the hysteresis, the dehumidification control is stopped if it was active. The default value is: [*0ºC*] for comfort, [*1ºC*] for standby and economic and [*2ºC*] for protection.

- **Return Hysteresis** [*0…5…200*] [*x0,1ºC*]: Hysteresis to avoid an oscillation around the temperature hysteresis. Common to all special modes.

- **Fan Speed** [*0...10...100*] [*%*]: Fan speed during dehumidification control (while fan coil valve is open). It is recommended to be as low as possible.

- **Dehumidification in Occupied Room** [*disabled/enabled*]: enables or disables the dehumidification control when the room is occupied.

In addition to the above-mentioned objects, the following objects related to dehumidification are also available:

- "**[HTx] [F] Current Humidity**": must be linked with the humidity object of the sensor.

- "**[HTx] [F] Dehumidification Control**": allows enabling or disabling the dehumidification on runtime.

- "**[HTx] [F] Dehumidification Status**": indicates whether the dehumidification is active or not. It is sent to the bus every time its value changes.

3.1.7 "HEATING" TAB

The "Heating" tab lets the integrator set the algorithm and all the parameters involved in the Heating working mode of the thermostat. For a proper configuration it is important to first read the initial sections of this user manual.

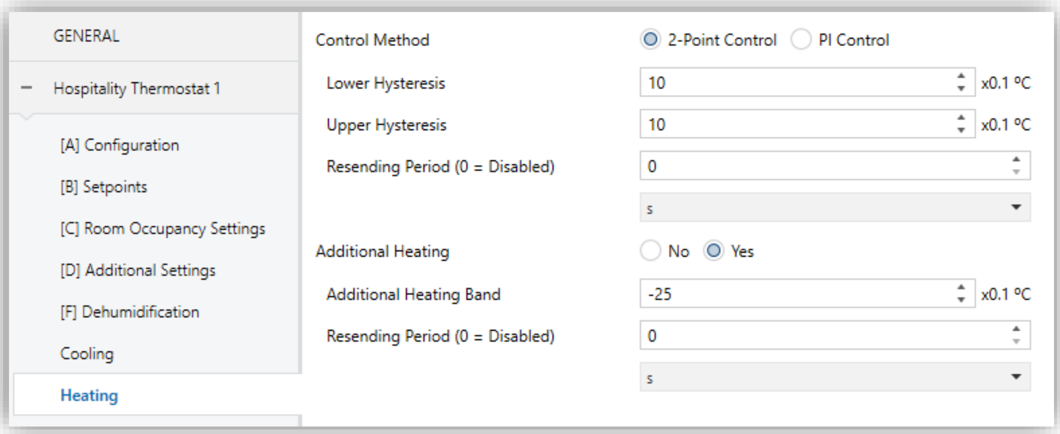


Figure 18. Heating.

- **Control Method** [*2-Point Control / PI Control*]: selects the control algorithm to be applied. See section 3.1.7.1 and section 3.1.7.2 respectively.

- **Resending Period (0 = Disabled)** [*0/1…255*] [*s/min/h*]: sets every how much time (between 1 and 255 seconds, minutes or hours) the control variable (i.e., object "**[HTx] [Heating] Control Variable**") will be sent to the bus. The value "0" disables the sending.

- **Additional Heating** [*No / Yes*]: enables or disables the Additional Heating function (see section 2.7). When enabled, the "**[HTx] [Heating] Additional Heat**" one-bit object will become available, as well as the parameters **Additional Heating Band** ([*-100…-25…-5*] tenths of a degree) and **Resending Period (0 = Disabled)** ([*0/1…255*][*s/min/h*]; the value "0" disables the sending).

3.1.7.1 2-POINT CONTROL

After selecting the two-point hysteresis control method (see section 2.6.1), the following parameters must be configured:

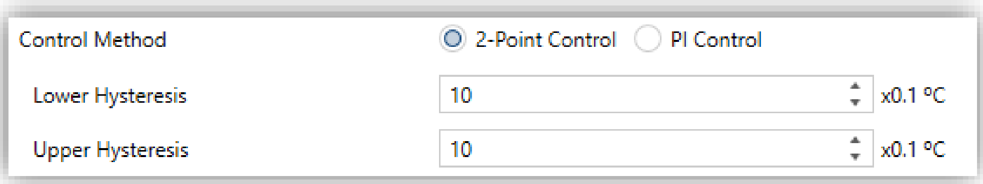


Figure 19. Two-Point Hysteresis Control Method.

- **Lower Hysteresis** [1…10…200] [x0,1ºC]: defines the value of the lower hysteresis, i.e., the margin below the setpoint temperature.

- **Upper Hysteresis** [1…10…200] [x0,1ºC]: sets the value of the upper hysteresis, i.e., the margin over the setpoint temperature.

The control variable is the "**[HTx] [Heating] Control Variable**" one-bit object, which will throw the value "1" when the thermostat considers that the room needs to be heated and the value "0" when the heating system can remain off. This variable will be sent periodically, according to the aforementioned parameter **Resending Period**.

3.1.7.2 PI CONTROL

After selecting the PI control method (see section 2.6.2), the following parameters must be configured:

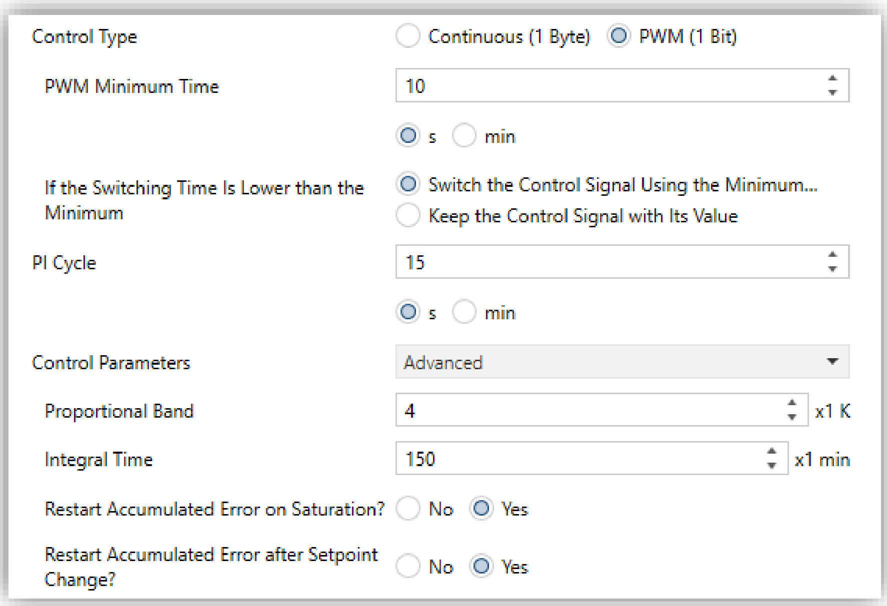


Figure 20. PI Control.

The control variable ("**[HTx] [Heating] Control Variable**") in this case may be either a one-byte or a one-bit object, depending on the configuration of the **Control Type**.

- **Control Type** [Continuous (1Byte) / PWM (1 Bit)]: sets whether the climate system valve should be controlled through precise positioning or through on/off orders.

  In case of choosing "Continuous (1byte)", the following objects will be available:

- "**[HTx] [Heating] Control Variable**": one-byte control variable that will reflect the degree of openness required in the valve (100% = entirely open; 0% = entirely closed).
- "**[HTx] [Heating] PI State**": one-bit object that will remain "0" while the PI signal is equal to 0%, and will be set to "1" when the PI signal is greater than 0%

In the second case, "PWM (1 bit)", these objects will be available together with another new one-bit object:

- "**[HTx] [Heating] Control Variable**": although the same name as the above one-byte variable, will alternatively adopt the values "1" and "0" depending on the cycle time (**PI Cycle** [*0…15...255*] [*s / min*]) so that the time proportion between the two states equals the aforementioned degree of openness

Moreover, when the control type is set to "PWM (1 bit)", the following specific parameters need to be configured:

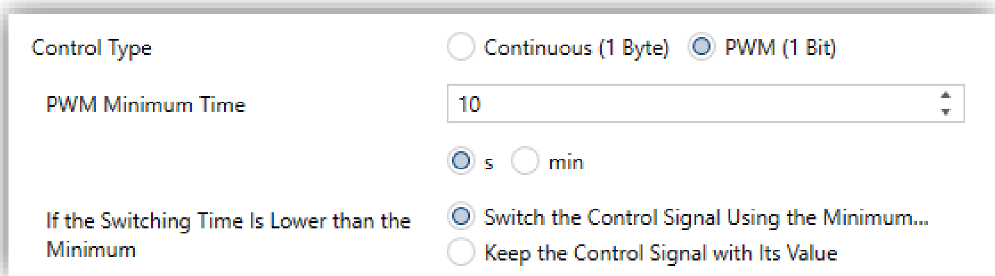


Figure 21. PWM Control (1 bit).

- **PWM Minimum Time** [*1…10…255*] [*s*] / [*1…30*] [*min*]: minimum time the control signal should stay unchanged, in order to prevent rapid relay commutations.
- **If the Switching Time Is Lower than the Minimum** [*Switch the Control Signal Using the Minimum Time / Keep the Control Signal with Its Value*]: sets what to do when the control signal needs to switch its state faster than what the above parameter allows: delay the commutation or do not perform the state switch.

- **PI Cycle** [*0…15…255*] [*s/min*]: sets every how much time the required degree of openness of the valve or, (in the case of the PWM modulation), the proportion between the intervals the signal is "1" and "0" will be re-calculated.

- **Control Parameters** [*Warm Water (5k/150min) / Floor Heating (5K/240min) / Electric Heating (4K/100min) / Blow Convector (4K/90min) / A/C Split (4K/90min) / Advanced*]: defines the desired values for the K and T parameters of the PI algorithm. It is highly encouraged to make use of the pre-set values; see ANNEX I: Pre-set Values for the PI Control, however it is possible to specify custom values ("Advanced"). Selecting the latter brings the following parameters.

  - **Proportional Band** [*1…4…15*]: defines the value for K (the proportional constant).

  - **Integral Time** [*5…150…255*] [*min*]: sets a value for T.

  - **Restart Accumulated Error on Saturation?** [*No / Yes*]: activates or deactivates this function during the algorithm application (see section 2.6.2). In case of selecting any of the pre-set values for the control parameters, this option will be implicitly activated.

  - **Restart Accumulated Error after Setpoint Change?** [*No / Yes*]: activates or deactivates this function during the algorithm application (see section 2.6.2). In case of selecting any of the pre-set values for **control parameters**, this option will be implicitly activated.

3.1.8 "COOLING" TAB

The "Cooling" tab lets the integrator set the algorithm and all the parameters involved in the Cooling working mode of the thermostat. For a proper configuration it is important to first read the initial sections of this user manual.

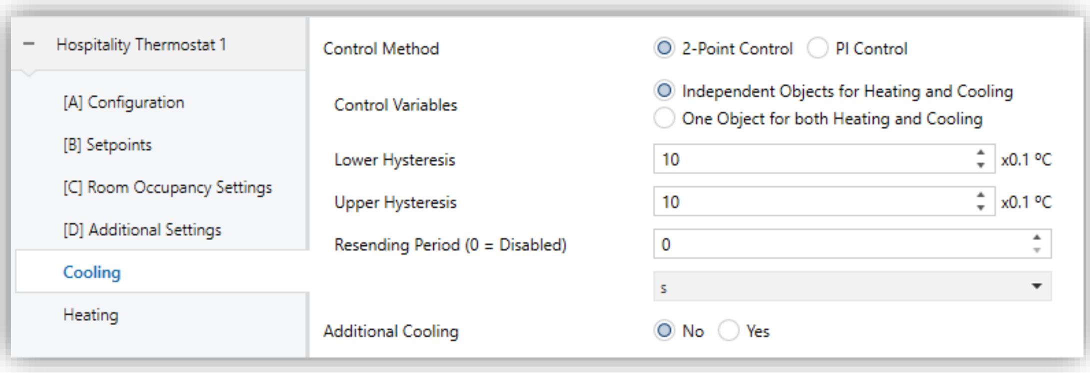


Figure 22. Cooling.

The parameters and communication objects involved are analogous to those of the “Heating” tab (see section 3.1.7), using the nomenclature "**[Cooling]**" instead of "**[Heating]**" in the object names. In addition, this tab has the following differences:

- The pre-set options for the **Control Parameters** are in this case [*Cooling Ceiling (5K/240min) / Blow Convector (4K/90min) / A/C Split (4K/90min) / Advanced*] (see ANNEX I: Pre-set Values for the PI Control).

- In the particular case of having **the two operating modes** of the thermostat enabled (Heating and Cooling; see section 3.1.1), this window will include the following parameter:

  - **Control Variables** [*Independent Objects for Heating and Cooling / One Object for both: Heating and Cooling*]: sets whether to send the control orders through the same communication object both under the Cooling and the Heating modes, or whether to send the Heating orders and the Cooling orders through separate objects, which is the option selected by default.

Note: *if “One Object for both: Heating and Cooling” is combined with “**Send Both H/C Control Signals Periodically**” (see section 3.1.1), the latter will be ignored – the thermostat will only send the value of the control variable of the current mode*.

ANNEX I: PRE-SET VALUES FOR THE PI CONTROL

The tables below show the different profiles for the PI Control that have been pre-set in the Hospitality thermostat, together with the corresponding values of K and T.

Profile	K	T (minutes)	Restart Accumulated Error
Warm Water	5	150	Yes
Floor Heating	5	240	Yes
Electric Heating	4	100	Yes
Blow Convector	4	90	Yes
A/C Split	4	90	Yes

Table 3. PI Control Profiles for the Heating Mode

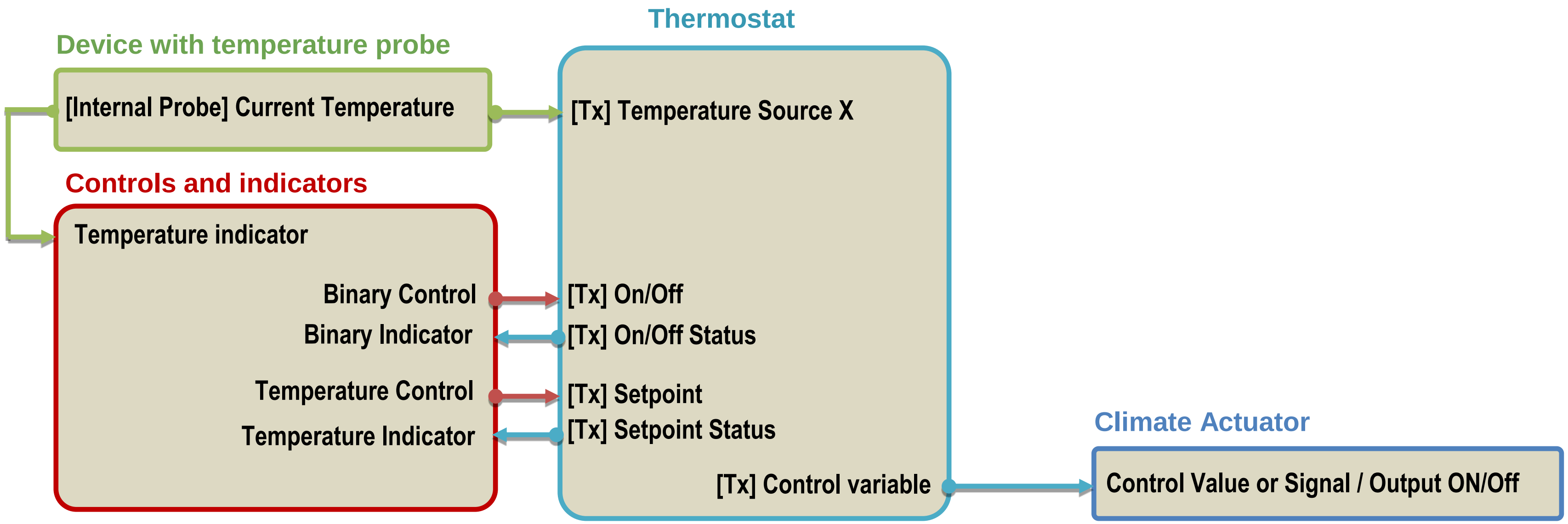
Profile	K	T (minutes)	Restart Accumulated Error
Cooling Ceiling	5	240	Yes
Blow Convector	4	90	Yes
A/C Split	4	90	Yes

Table 4. PI Control Profiles for the Cooling Mode

These values have been obtained empirically, and are therefore optimised for the most common climate control contexts. Making use of them is highly encouraged, leaving the manual configuration of these values for very specific situations and for specialists with experience in advanced climate control.

ANNEX II: OBJECT LINKING SCHEME

The following scheme shows an example of how to link the objects of a thermostat:



Note that:

- The names of the objects may vary depending on the device.
- It is possible that the same KNX device includes the controls and indicators, the temperature probe and the thermostat (e.g. a Z41). In this case <u>it is also necessary to link the objects</u> via group addresses

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