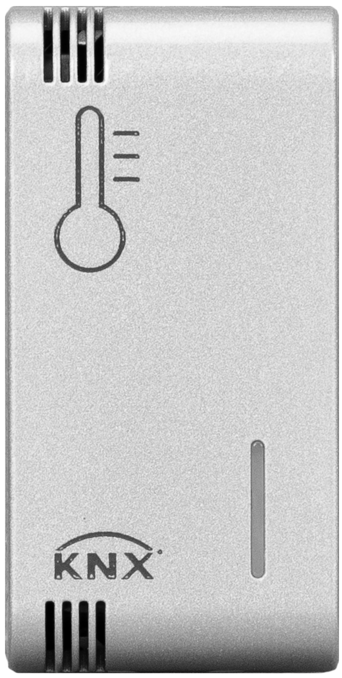
KNX Easy flush-mounting temperature sensor



GW 1x769

Technical Manual

Contents

1 Introduction

This manual explains the functions of the "**KNX Easy temperature sensor**" (GW1x769) device and how they are set and configured with the aid of the ETS configuration software.

2 Application

The Easy flush-mounting temperature sensor is used, with the aid of an Easy timed thermostat (GW 10 764 - GW 12 764 - GW 14 764) or an Easy thermostat (GW 10 765 - GW 12 765 – GW 14 765), to manage the temperature of the environment where it is installed or of another environment when used with an external temperature sensor.
The sensor is not equipped with its own visualisation and command elements, so it must be used with an Easy device (e.g. an Easy thermostat or an Easy timed thermostat) that can control its parameters (HVAC or Setpoint mode and operating type).
The temperature sensor has various functions:

- Temperature control
    - 2 points, with ON/OFF commands;
    - proportional-integral control with PWM commands.
- Fan coil management
    - fan coil speed control with ON/OFF selection commands;
    - management of 2-way or 4-way systems, with ON/OFF commands.
- Operating mode setting
    - from the BUS, with a 1 byte object.
- Temperature measurement
    - with a built-in sensor;
    - mixed built-in sensor/outside temperature sensor with definition of the relative weight.
- Underfloor sensor
    - setting of threshold value for floor temperature alarm.
- Temperature control for specific zones:
    - with the operating mode received from the Master device, and the use of a local setpoint;
    - with the Setpoint value received from the Master device, and local residual current device for temperature.
- Scenes
    - memorisation and activation of 8 scenes (value 0..7).
- Other functions:
    - setting of the functioning type (heating/air cooling) from the BUS;
    - transmission of the status information (mode, type), measured temperature and current setpoint on the BUS;
    - auxiliary input for the window contact function;

2.1 Association limits

Maximum number of group addresses: 254
Maximum number of associations: 254

This means that up to 254 group addresses can be defined, and up to 254 associations can be made (communication objects and group addresses).

3 *“Settings”* Menu

The ***Settings*** menu contains the parameters used to enable the different functions implemented by the device. The basic structure of the menu is as follows:

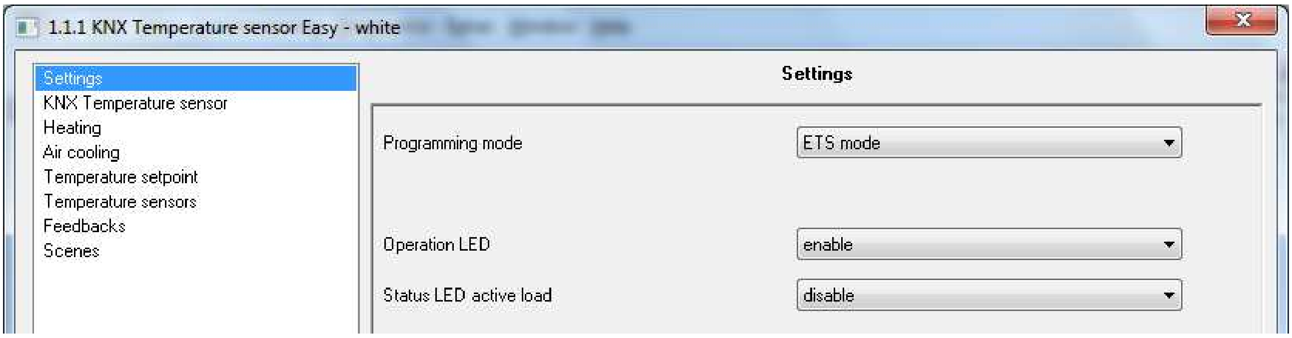


Fig. 3.1

3.1 Parameters

➢ *3.1.1 Programming mode*

The database of the device for the configuration with ETS software allows you to configure the main operating parameters, and also gives you the possibility to reconfigure the device with the factory parameters for E-mode operation and this parameter makes it possible to differentiate the two behaviours; the values that can be set are:

- **Easy mode** **(default value)**
- ETS mode

By selecting **Easy mode**, additional parameters for the configuration of the device are not displayed as this value is used to restore the device to its factory settings for correct operation in easy mode (E-Mode).
ETS mode allows the visualisation and configuration of the main device operating parameters (S-Mode).

➢ *3.1.2 Operation LED*

This is used to enable the luminous signalling of the green LED that signals that the device is powered by the BUS; the values that can be set are:

- disable
- **enable** **(default value)**

➢ *3.1.3 Status LED active load*

Used to enable the luminous signalling of the red LED that identifies the activation of the active functioning type solenoid valve; the values that can be set are:

- **disable (default value)**
- enable

Selecting **enable** the red LED turns on when the control algorithm activates the relative temperature regulation valve; if the valve feedback is active, the red signal flashes if there is no valve status feedback.

4 *"KNX temperature sensor"* menu

The **KNX temperature sensor** menu contains the parameters used to enable the various functions implemented by the device for the remote control of the KNX sensor that, not having its own display and control device, must rely on another device to control and display the operating parameters.
The device is configured so it can manage the temperature adjustment system with the aid of a remote device (such as the timed thermostat/programmer or KNX Easy flush-mounting thermostat). With this configuration the device does not control the entire system but only a part of it, called a zone. Whereas there is a remote device in the system that controls its mode and functioning type; in this case, the KNX sensor controls the temperature of the environment where it is located whereas it is the remote device that decides the functioning set by the user. The operating parameters of the device cannot be changed locally.
The device management of the temperature adjustment functioning type (heating/cooling) is managed remotely via the communication object ***Functioning type input*** (Data Point Type: 1.100 DPT_Heat/Cool) which makes it possible to receive the remote functioning type setting commands. When the application is downloaded, the set functioning type is HEATING.
The basic structure of the menu is as follows:

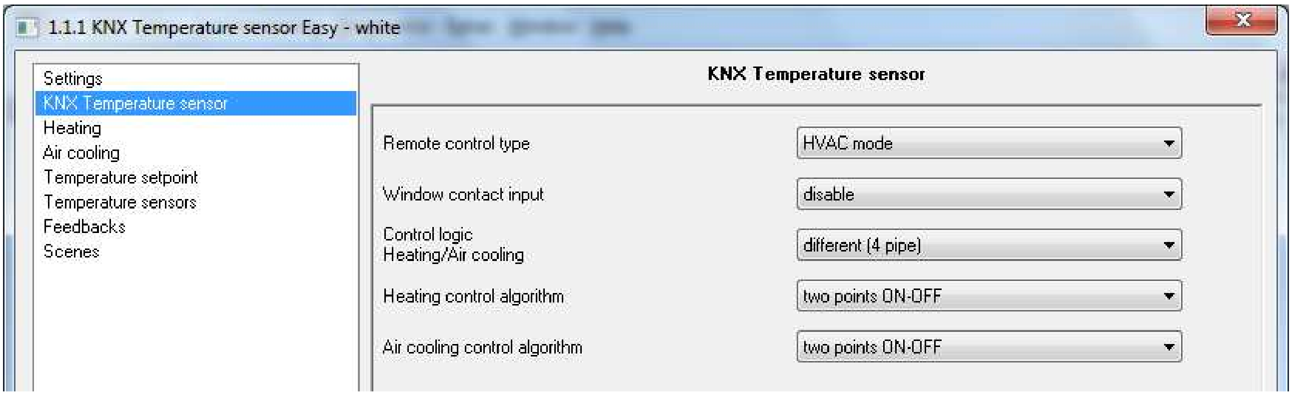


Fig. 4.1

4.1 *Parameters*

➢ *4.1.1 Remote control type*

The device can be controlled remotely through a single setpoint or by changing the active HVAC mode; the parameter **"Remote control type"** is used to set the type of control the remote device executes on the KNX sensor; the values that can be set are:

- **HVAC mode** **(default value)**
- setpoint

Selecting **HVAC mode** displays the communication object ***HVAC mode input*** (Data Point Type: 20.102 DPT_HVACMode) via which the remote device changes the HVAC mode; selecting **setpoint** displays the communication object ***Setpoint input*** (Data Point Type: 9.001 DPT_Value_Temp) via which the remote device changes the operating setpoint.

There is a priority constraint between the different functions of the device and the different communication objects that can be used for the remote commands, as summarised in the following table:

Priority	Object	Dimensions
Maximum Minimum	Window contact function via the BUS/ Window contact function, aux input HVAC mode input/Setpoint input/Scene	1 bit/- 1 byte/2 byte/1 byte

If the remote control type is HVAC mode, between the various setpoints belonging to the same functioning type, there is a value setting limit that must be respected, which is determined by the following relationship:

– $T_{antifreeze} \leq T_{economy} \leq T_{precomfort} \leq T_{comfort}$ in heating mode ("T" indicates the generic value of the mode setpoint)
– $T_{comfort} \leq T_{precomfort} \leq T_{economy} \leq T_{high\ temp.\ protection}$ in air cooling mode ("T" indicates the generic value of the mode setpoint)

If the remote control type is setpoint, between the various setpoints belonging to the same functioning type, there is a value setting limit that must be respected, which is determined by the following relationship:

– $T_{building\ protection} \leq T_{functioning}$ in heating mode ("T" indicates the generic value of the setpoint)
– $T_{functioning} \leq T_{building\ protection}$ in air cooling mode ("T" indicates the generic value of the setpoint)

➢ *4.1.2 Window contact input*

The device implements the window contact function which makes it possible, when a window open condition is detected by a remote device, to force the KNX sensor to the HVAC OFF/Building Protection mode if the remote control type is **HVAC mode** or to set the BUILDING PROTECTION setpoint if the stand alone or master/slave control type is **setpoint**; when the window closed condition is restored, the KNX sensor resumes the condition it was in beforehand. The parameter **"Window contact input"** is used to enable the "window contact" function of the KNX sensor. The values that can be set are:

- disable
- **enable (default value)**

Select **enable** to view the ***Window status input*** object (Data Point Type: 1.019 DPT_Window_Door) which makes it possible for the device to be aware of the window status.

➢ *4.1.3 Control logic Heating/Air cooling*

The KNX sensor implements a stand alone control logic by using various control algorithms. Given the different types of temperature adjustment systems, it is possible to dedicate a common solenoid valve control object to the heating and air cooling system or dedicate one to each of the two types of operation. The parameter **"Control logic Heating/Air cooling"** is used to define if the system control logic, and as a result the control communication object, is common for the heating and air cooling or if it is different; the values that can be set are:

- common
- **different (default value)**

Select **common** to view the parameters **"Heating/air cooling control algorithm"** and **"Heating/air cooling valve status feedback"**, whereas select **different** to view the parameters **"Heating control algorithm"** and **"Air cooling control algorithm"**.

➢ *4.1.4 Heating control algorithm*

This is used to define the control algorithm used for the heating system; the values that can be set are:

- **2 points ON-OFF (default value)**
- PWM proportional-integral
- fan coil with ON-OFF speed control

Select **2 points ON-OFF** to view the parameter **"Regulation differential (tenth of °C)"** in the **Heating** menu and the communication object ***Heating valve switching*** (Data Point Type: 1.001 DPT_Switch) via which the device sends the command telegrams.
Select **PWM proportional integral** to view the parameters **"Select heating system"**, **"Proportional band"**, **"Integration time"** and **"Cycle time"** in the **Heating** menu and the communication object ***Heating valve switching*** (Data Point Type: 1.001 DPT_Switch) via which the device sends the command telegrams.
Select **fancoil with ON-OFF speed control** to view the parameters **"Valve regulation differential (tenth of °C)"**, **"Speed 1 regulation differential (tenth of °C)"**, **"Speed 2 regulation differential (tenth of °C)"**, **"Speed 3 regulation differential (tenth of °C)"**, **"Speed 1 inertia time (seconds)"**, **"Speed 2 inertia time (seconds)"**, **"Speed 3 inertia time (seconds)"** and **"Fancoil speed status feedback"** in the **Heating** menu and the communication objects ***Heating fan V1 switching***, ***Heating fan V2 switching*** and ***Heating fan V3 switching***.

➢ *4.1.5 Air cooling control algorithm*

This is used to define the control algorithm used for the air cooling system; the values that can be set are:

- **2 points ON-OFF** **(default value)**
- PWM proportional-integral
- fan coil with ON-OFF speed control

Select **2 points ON-OFF** to view the parameter **"Regulation differential (tenth of °C)"** in the **Air cooling** menu and the communication object ***Air cooling valve switching*** (Data Point Type: 1.001 DPT_Switch) via which the device sends the command telegrams.
Select **PWM proportional integral** to view the parameters **"Select air cooling system"**, **"Proportional band"**, **"Integration time"** and **"Cycle time"** in the **Air cooling** menu and the communication object ***Air cooling valve switching*** (Data Point Type: 1.001 DPT_Switch) via which the device sends the command telegrams.
Select **fancoil with ON-OFF speed control** to view the parameters **"Valve regulation differential (tenth of °C)"**, **"Speed 1 regulation differential (tenth of °C)"**, **"Speed 2 regulation differential (tenth of °C)"**, **"Speed 3 regulation differential (tenth of °C)"**, **"Speed 1 inertia time (seconds)"**, **"Speed 2 inertia time (seconds)"**, **"Speed 3 inertia time (seconds)"** and **"Fancoil speed status feedback"** in the **Air cooling** menu and the communication objects ***Air cooling fan V1 switching***, ***Air cooling fan V2 switching*** and ***Air cooling fan V3 switching***.

➢ *4.1.6 Heating/air cooling control algorithm*

This is used to define the control algorithm used for the heating system as well as for the air cooling system, due to the fact that the control logic is common; the values that can be set are:

- **2 points ON-OFF** **(default value)**
- PWM proportional-integral
- fan coil with ON-OFF speed control

Select **2 points ON-OFF** in the **Heating** and **Air cooling** menus to display the parameters **"Regulation differential (tenth of °C)"** and the communication object ***Heating/air cooling valve switching*** (Data Point Type: 1.001 DPT_Switch) via which the device sends the command telegrams.
Select **PWM proportional integral** in the **Heating** and **Air cooling** menus to display the parameters **"Select heating system(air cooling** in the **Air cooling menu)"**, **"Proportional band"**, **"Integration time"** and **"Cycle time"** and the communication object ***Heating/air cooling valve switching*** (Data Point Type: 1.001 DPT_Switch) via which the device sends the command telegrams.
Select **fancoil with ON-OFF speed control** to view the parameter **"Valve regulation differential (tenth of °C)"** and in the **Heating** and **Air cooling** menus to view the parameters **"Speed 1 regulation differential (tenth of °C)"**, **"Speed 2 regulation differential (tenth of °C)"**, **"Speed 3 regulation differential (tenth of °C)"**, **"Speed 1 inertia time (seconds)"**, **"Speed 2 inertia time (seconds)"**, **"Speed 3 inertia time (seconds)"** and **"Fancoil speed status feedback"** and the communication objects ***Heating fan V1 switching***, ***Heating fan V2 switching***, ***Heating fan V3 switching***, ***Air cooling fan V1 switching***, ***Air cooling V2 switching*** and ***Air cooling V3 switching***.

If the control algorithm is fancoil, the format of the heating/air cooling solenoid valve commands (2-way system) is independent on that of the fancoil speed control; the solenoid valve control logic when the selected algorithm is fancoil is **2 points ON-OFF**. Via the communication object ***Heating/air cooling valve switching*** (Data Point Type: 1.001 DPT_Switch) the device sends the command telegrams to the solenoid valve.

The parameter **"Heating/air cooling solenoid valve regulation differential (tenth of °C)"** is used to set the regulation differential value of the 2 points control of the fancoil operating solenoid valve, as mentioned in the Control algorithms paragraph; the value is the same for the heating system and for the air cooling system. The values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

The parameter **"Heating/air cooling valve status feedback"** is used to enable the device to receive feedback from the actuator that commands the heating/air cooling solenoid valve; in this way, the device is able to receive the telegram after the solenoid valve switched and to repeat the command if the switching did not take place. The values that can be set are:

- disable
- **enable (default value)**

Select **disable** to view the parameter **"Command repetition period with disabled feedback"**; select **enable** to view the communication object ***Heating/air cooling valve status feedback*** (Data Point Type: 1.001 DPT_Switch).
When BUS voltage is restored, the device sends the read request command via the ***Heating/air cooling valve status feedback*** object to be updated about the status of the heating/air cooling solenoid valve.

With feedback enabled, after the device sends the switching command to the solenoid valve, it waits for one minute of its clock for the actuator to send the feedback that switching took place; if this does not take place, it sends the command again to the solenoid valve every minute until it receives the feedback of correct switching. It can happen that, during normal operation of the temperature adjustment, the actuator status can be changed by an entity external of the sensor, that forces its status, modifying it. In this case, the device repeats the valve switching command to realign the status of the actuator with the one determined by the control logic of the sensor, triggering the process for waiting for confirmation and repeating the command until the confirmation is received.

With the solenoid valve status feedback disabled, it may be useful to cyclically repeat the command to the actuator that manages the solenoid valve so that if the first command telegram is lost, one of the subsequent ones will be received eventually. The parameter **"Command repetition period with disabled feedback"** is used to define the frequency of the cyclical sending; the values that can be set are:

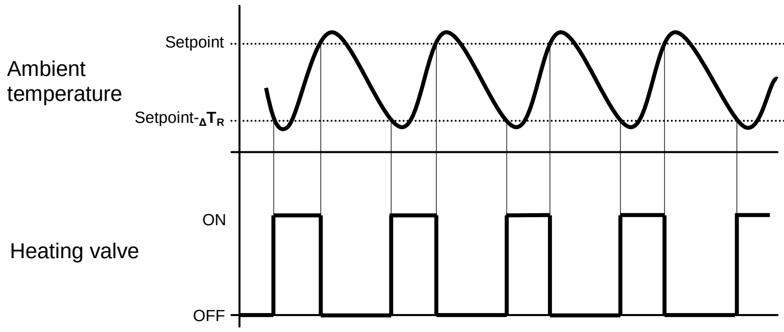
- no repetition
- 1 minute
- 2 minutes
- 3 minutes
- 4 minutes
- **5 minutes (default value)**

4.2 Control algorithms

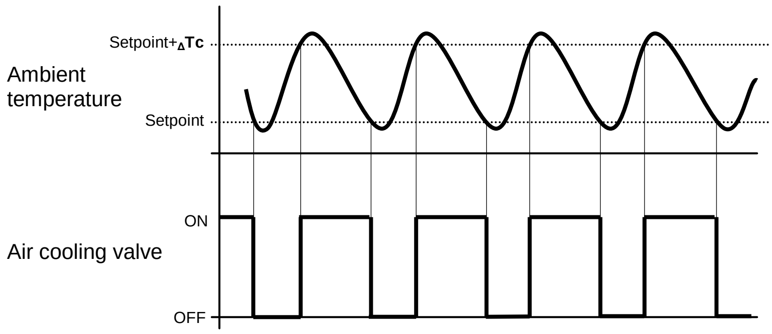
Below there is more information about the available control algorithms, regardless if the control logic is common or different for the functioning types (heating/air cooling):

- ***2 points ON-OFF***

The algorithm used for controlling the temperature adjustment system is the classic type that is called 2 points control. This type of control involves the turning on and off of the temperature adjustment system following a hysteresis cycle. This means that there is not a single threshold that discriminates between the turning on and off of the system, but there are two.



When the measured temperature is lower than the value setpoint-ΔT_R“ (where ΔT_R identifies the value of the heating regulation differential) the device turns on the heating system, sending the relative BUS command to the actuator that manages it; when the detected temperature reaches the fixed setpoint value, the device turns off the heating system, sending the relative BUS command to the BUS that manages it.
This makes it clear that there are two decision thresholds for turning the heating system on and off, the first consists of the value “setpoint- ΔT_R“ below which the device turns on the system, the second consists of the setpoint value that was set, above which the device turns off the system.



When the measured temperature is higher than the value “setpoint+ ΔTc“ (where ΔTc identifies the air cooling regulation differential) the device turns on the air cooling system, sending the relative BUS command to the actuator that manages it; when the detected temperature reaches the fixed setpoint value, the device turns off the air cooling system, sending the relative BUS command to the BUS that manages it.
This makes it clear that there are two decision thresholds for turning the air cooling system on and off, the first is the setpoint value that was set, below which the device turns off the system, the second is the value “setpoint+ΔTc“ above which the device turns on the system.
To avoid the continuous switchovers of the solenoid valves, after an OFF-ON-OFF sequence, the next ON command can only be sent after at least 2 minutes have elapsed.

- ***PWM proportional-integral***

The algorithm used to control the temperature adjustment system allows you to drastically reduce the times subject to thermal inertia and introduced by the 2 points control, called PWM control. This type of control involves the modulation of the impulse duty-cycle, represented by the temperature adjustment system activation time, on the basis of the difference between the fixed set-point and the temperature effectively detected. Two components are needed to calculate the output function: the proportional component and the integral component.

$$u(t) = K_p e(t) + K_i \int_0^t e(\tau)\, d\tau$$

Proportional component

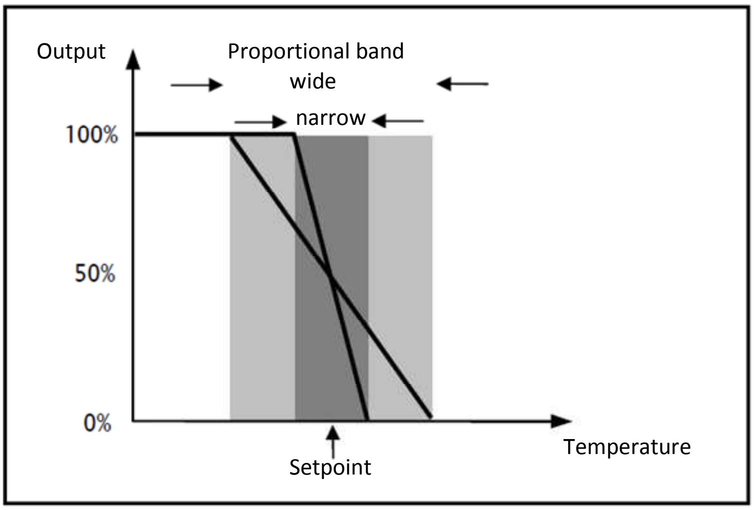
In the proportional component, the output function is proportional to the error (difference between setpoint and measured temperature).

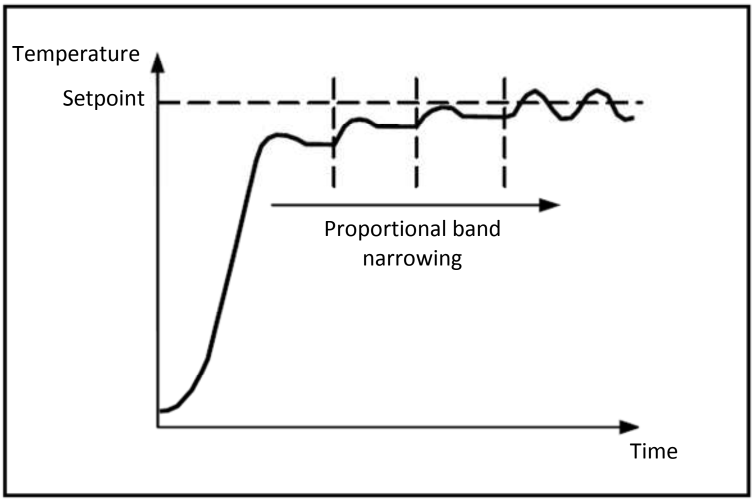
$$P_{\text{out}} = K_p\, e(t)$$

Once the proportional band is defined, the duty-cycle within the band varies between 0% and 100%; outside of the band, the duty-cycle will be maximum or minimum depending on the reference limits.

The width of the proportional band determines the extent of the response to the error. If the band is too “narrow”, the system will oscillate as it becomes more reactive; if the band is too "wide" the control system is slow. The ideal situation is when the proportional band is as narrow as possible without causing oscillations.

The diagram below shows the effect of narrowing the proportional band until the oscillation point of the output function. A "wide" proportional band results as a straight line in the control, but with an initial error between the setpoint and the actually perceptible temperature. As the band becomes narrower, the temperature approaches the reference value (setpoint) until it becomes unstable and starts to oscillate around it.



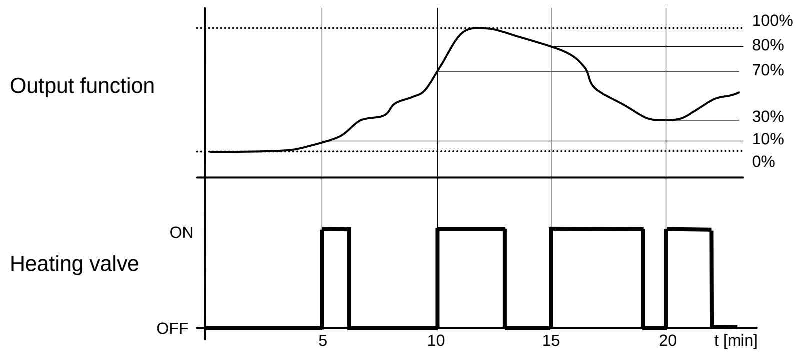


Integral component

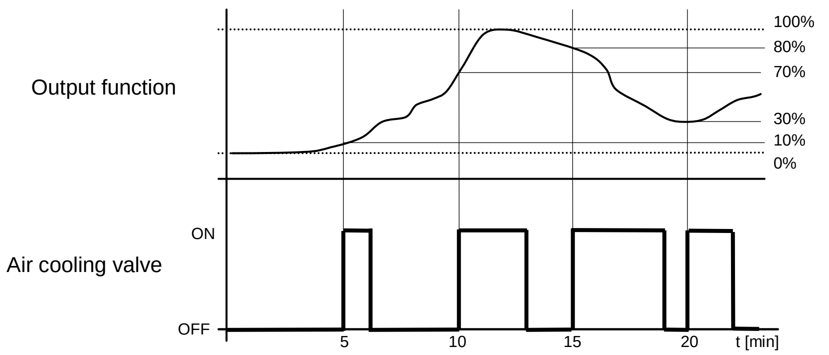
The contribute of the integral period is proportional to the error (difference between the setpoint and the measured temperature) and its duration. The integral is the sum of the instantaneous error for every moment of time and provides the accumulated offset that should have been previously corrected. The accumulated error is then added to the regulator output.

$$I_{\mathrm{out}} = K_i \int_0^t e(\tau)\, d\tau$$

The integral period accelerates the dynamics of the process towards the setpoint and eliminates the residuals of the stationary error status that takes place with a pure proportional controller.
The integration time is the parameter that determines the action of the integral component. The longer the integration time, the slower the modification of the output and hence the slower the system response. If the time is too short, the threshold value will be exceeded (overshoot), and the function will swing around the set-point.



The device keeps the heating system switched on for a cycle time percentage that depends on the output function of the proportional-integral control; the device continuously regulates the heating system, modulating the system turning on-off times with a duty-cycle (shown to the right along the vertical axis) that depends on the output function value calculated at every time interval equal to the cycle time. The cycle time is reinitialised every time the reference set-point is modified.
With this type of algorithm, there is no longer a hysteresis cycle on the heating device, so the inertia times (system heating and air cooling times) introduced by the 2 points control are eliminated. This produces energy savings because the system does not remain switched on when it is not needed and, once the required temperature has been reached, it continues to provide a heat limited contribution to compensate for the environmental heat dispersion.

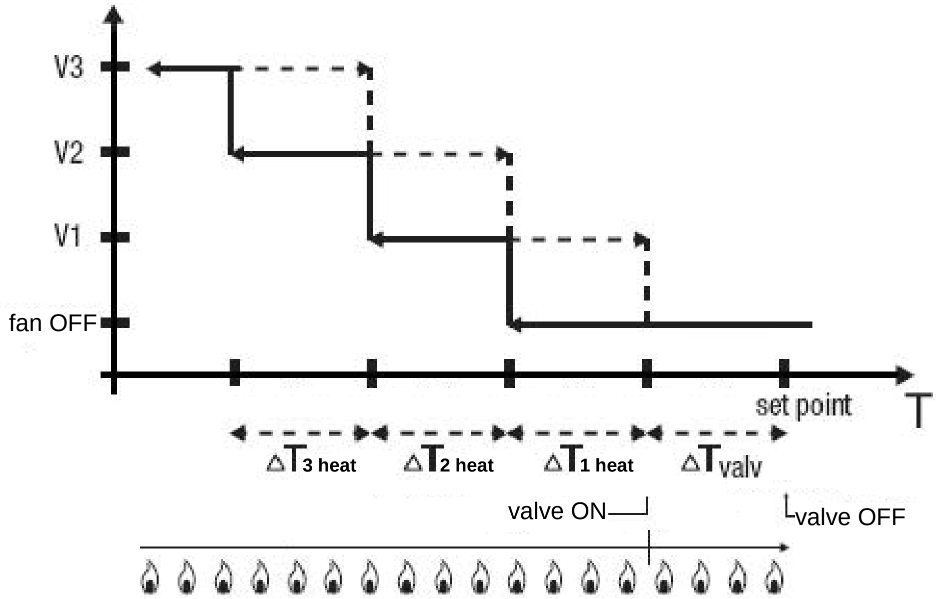


As seen in the figure, the device keeps the air cooling system switched on for a cycle time percentage that depends on the output function of the proportional-integral control; the device continuously regulates the air cooling system, modulating the system turning on-off times with a duty-cycle (shown to the right along the vertical axis) that depends on the output function value calculated at every time interval equal to the cycle time. The cycle time is reinitialised every time the reference set-point is modified.
With this type of algorithm, there is no longer a hysteresis cycle on the air cooling device, so the inertia times (system air cooling and heating times) introduced by the 2 points control are eliminated. This produces energy savings because the system does not remain switched on when it is not needed and, once the required temperature has been reached, it continues to provide a limited contribution of cold air to compensate for the contribution of environmental heat.

- ***fan coil with ON-OFF speed control***

The type of control that is applied when the fancoil control is enabled is similar to the 2 points control analysed in previous sections, which is to turn the fancoil speed on /off based on the difference between the setpoint that was set and the measured temperature.
The substantial difference with the 2-point algorithm is that, in this case, there is only one stage on which the hysteresis cycle is carried out, fixing the speed on and off thresholds, but there can be three (depending on the number of fancoil speeds); substantially, this means that each stage corresponds to a speed and when the difference between the measured temperature and the setpoint that was set causes a certain speed to be turned on, this means that before turning on the new speed, the other two must absolutely be turned off.

HEATING

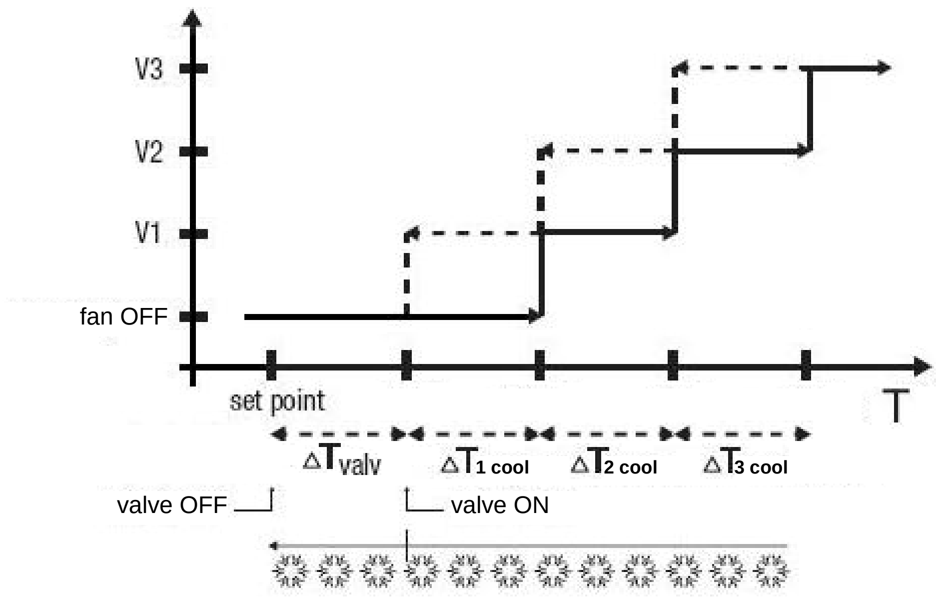


The figure refers to the control of the fancoil speeds with three operating stages for heating. The chart shows that each stage has a hysteresis cycle, and each speed is associated with two thresholds that determine its activation and deactivation. The thresholds are determined by values set for the various regulation differentials, and can be summarised as follows:

- Speed V1 (1st stage): the speed is turned on when the temperature value is lower than the value "setpoint-ΔT_{valv}-$\Delta T_{1\ heat}$" and turned off when the temperature value reaches the value "setpoint-ΔT_{valv}" (or the "setpoint" value if $\Delta T_{1\ heat}$=0). The first speed is also turned off when a higher speed needs to be activated
- Speed V2 (2nd stage): the speed is turned on when the temperature value is lower than the value "setpoint-ΔT_{valv}-$\Delta T_{1\ heat}$-$\Delta T_{2\ heat}$" and turned off when the temperature value reaches the value "setpoint-ΔT_{valv}-$\Delta T_{1\ heat}$". The second speed is also turned off when the V3 speed needs to be activated
- Speed V3 (3rd stage): the speed is turned on when the temperature value is lower than the value "setpoint-ΔT_{valv}-$\Delta T_{1\ heat}$-$\Delta T_{2\ heat}$-$\Delta T_{3\ heat}$" and turned off when the temperature value reaches the value "setpoint-ΔT_{valv}-$\Delta T_{1\ heat}$-$\Delta T_{2\ heat}$"

With regard to the heating solenoid valve, once the measured temperature is lower than the value "setpoint-ΔT_{valv}", the sensor sends the activation command to the solenoid valve that manages the heating system; the solenoid valve is deactivated when the detected temperature reaches the fixed set-point value. In this way, the heating of the fan coil can also be exploited for irradiation, without any speed being activated.

AIR COOLING



The figure refers to the control of the fancoil speeds with three operating stages for air cooling. The chart shows that each stage has a hysteresis cycle, and each speed is associated with two thresholds that determine its activation and deactivation. The thresholds are determined by values set for the various regulation differentials, and can be summarised as follows:

- Speed V1 (1st stage): the speed is turned on when the temperature value is higher than the value "setpoint+ΔT_{valv}+ΔT_{1cool}" and turned off when the temperature value reaches the value "setpoint+ΔT_{valv}" (or the "setpoint" value if $\Delta T_{1\ cool}$=0). The first speed is also turned off when a higher speed needs to be activated
- Speed V2 (2nd stage): the speed is turned on when the temperature value is higher than the value "setpoint+ΔT_{valv}+ΔT_{1cool}+ΔT_{2cool}" and turned off when the temperature value reaches the value "setpoint+ΔT_{valv}+$\Delta T_{1\ cool}$". The second speed is also turned off when a V3 speed needs to be activated
- Speed V3 (3rd stage): the speed is turned on when the temperature value is higher than the value "setpoint+ΔT_{valv}+ΔT_{1cool}+ΔT_{2cool}+ΔT_{3cool}" and turned off when the temperature value reaches the value "setpoint+ΔT_{valv}+ΔT_{1cool}+ΔT_{2cool}"

With regard to the air cooling solenoid valve, once the measured temperature is higher than the value "setpoint+ΔT_{valv}", the sensor sends the activation command to the solenoid valve that manages the air cooling system; the solenoid valve is deactivated when the detected temperature reaches the fixed set-point value. In this way, the air cooling of the fan coil can also be exploited for irradiation, without any speed being activated.

To avoid continuous switchovers, the sensor can wait up to 2 minutes before sending the activation command to the actuator that controls the temperature adjustment system, or to the actuator channels that command the fan coil speeds.

5 “Heating” *menu*

The **Heating** menu contains the characteristic parameters of the load control algorithms for the heating system. The structure of the menu is as follows:

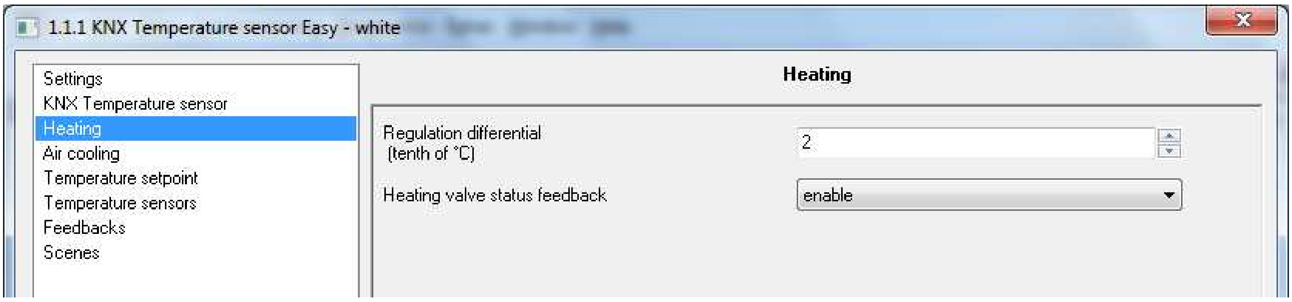


Fig. 5.1

5.1 Parameters

➢ *5.1.1 Regulation differential (tenth of °C)*

This is used to set the regulation differential value of the heating **2 points ON-OFF** or **2 points 0%-100%** control algorithm, already mentioned in the Control algorithms section, which, when subtracted from the value of the setpoint that was set, determines the threshold value below which the heating system is turned on in the 2 points control. The values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

➢ *5.1.2 Select heating system*

Used to automatically measure the operating parameters (Proportional band and Integration time) of the proportional integral algorithm based on the selected heating system. The values that can be set are:

- hot water heating
- **floor heating** **(default value)**
- fan coil unit
- electric heating
- customised

Selecting **hot water heating**, the parameters **“Proportional band”** and **“Integration time (minutes)”** will be displayed but cannot be modified, and the values **5.0 °C** and **150** are displayed.
Selecting **floor heating**, the parameters **“Proportional band”** and **“Integration time (minutes)”** will be displayed but cannot be modified, and the values **5.0 °C** and **240** are displayed.
Selecting **fan coil unit**, the parameters **“Proportional band”** and **“Integration time (minutes)”** will be displayed but cannot be modified, and the values **4.0 °C** and **90** are displayed.
Selecting **electric heating**, the parameters **“Proportional band”** and **“Integration time (minutes)”** will be displayed but cannot be modified, and the values **4.0 °C** and **100** are displayed.
Selecting **customised**, the parameters **“Proportional band”** and **“Integration time (minutes)”** will be displayed but cannot be modified.
It is not necessary to store the parameter **“Select heating system”** in the memory.

The parameter **“Proportional band”** is used to set the width of the PWM proportional band of the heating **PWM proportional integral** control algorithm, already mentioned in the Control algorithms paragraph, which, when subtracted from the value of the setpoint that was set, determines the lower limit of the proportional band used for the proportional integral control. The values that can be set are:

- 1.0 °C
- 1.5 °C
- **2.0 °C** **(default value)**

- 2.5 °C
- 3.0 °C
- 3.5 °C
- 4.0 °C
- 4.5 °C
- 5.0 °C
- 5.5 °C
- 6.0 °C
- 6.5 °C
- 7.0 °C
- 7.5 °C
- 8.0 °C
- 8.5 °C
- 9.0 °C
- 9.5 °C
- 10.0°C

The parameter **“Integration time”** is used to set the contribution of the integral action in the proportional integral control (see the Control algorithms paragraph). The values that can be set are:

- from 1 minute to 250 minutes with steps of 1 plus the value “no integral” (255), **60 (default value)**

Selecting **no integral**, the integral component is zero and the pure effect of proportional control is obtained.

The parameter **“Cycle time”** is used to set the value of the period within which the device carries out PWM modulation, modifying the duty-cycle. The values that can be set are:

- 5 minutes
- 10 minutes
- 15 minutes
- **20 minutes (default value)**
- 30 minutes
- 40 minutes
- 50 minutes
- 60 minutes

If the control algorithm is fancoil, the format of the heating solenoid valve commands (4-way system) is independent of that of the fancoil speed control; the solenoid valve control logic when the selected algorithm is fancoil is **2 points ON-OFF**. Via the communication object ***Heating valve switching*** (Data Point Type: 1.001 DPT_Switch) the device sends the command telegrams to the heating solenoid valve.
The parameter **“Valve regulation differential (tenth of °C)”** is used to set the regulation differential value of the 2 points control of the fancoil operating solenoid valve, as mentioned in the Control algorithms paragraph. The values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

The parameter **“Speed 1 regulation differential (tenth of °C)”** is used to set the value of the regulation differential of the first speed of the heating control algorithm **fancoil with ON-OFF speed control**, already mentioned in the Control algorithms paragraph; this value, subtracted from the “setpoint-ΔT_{valv}” determines the value of the threshold,under which speed 1 of the fancoil is turned on. The values that can be set are:

- from 0 to 20 with steps of 1, **2 (default value)**

Setting the value **0** obtains the condition “$\Delta T_{1\ heat}=\Delta T_{valv}$” for which the value of the speed 1 activation threshold is setpoint-ΔT_{valv}” and the off value is “setpoint”.

The parameter **“Speed 2 regulation differential (tenth of °C)”** is used to set the value of the regulation differential of the second speed of the heating control algorithm **fancoil with ON-OFF speed control**, already mentioned in the Control algorithms paragraph; this value, subtracted from the value “setpoint-ΔT_{valv}-$\Delta T_{1\ heat}$” determines the value of the threshold, under which speed 2 of the fancoil is turned on. the values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

The parameter **"Speed 3 regulation differential (tenth of °C)"** is used to set the value of the regulation differential of the third speed of the heating control algorithm **fancoil with ON-OFF speed control**, already mentioned in the Control algorithms paragraph; this value, subtracted from the value "setpoint-ΔT_{valv}-$\Delta T_{1\ heat}$-$\Delta T_{2\ heat}$" determines the value of the threshold, under which speed 3 of the fancoil is turned on. the values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

When, according to the "fancoil with speed control" algorithm, the device must turn on any speed and speed 1 is on, a delay can be inserted between the moment in which feedback is received that speed 1 is turned off (or the moment the command to turn off speed 1 is sent if the fancoil speed feedback is disabled) and the instant in which the command for turning on the new speed is sent; the parameter **"Speed 1 inertia time (seconds)"** is used to define the extent of the delay between turning off speed 1 and turning on the new speed. the values that can be set are:

- from **0 (default value)** to 10, with steps of 1

When, according to the "fancoil with speed control" algorithm, the device must turn on any speed and speed 2 is on, a delay can be inserted between the moment in which feedback is received that speed 2 is turned off (or the moment the command to turn off speed 2 is sent if the fancoil speed feedback is disabled) and the instant in which the command for turning on the new speed is sent; the parameter **"Speed 2 inertia time (seconds)"** is used to define the extent of the delay between turning off speed 1 and turning on the new speed. The values that can be set are:

- from **0 (default value)** to 10, with steps of 1

When, according to the "fancoil with speed control" algorithm, the device must turn on any speed and speed 3 is on, a delay can be inserted between the moment in which feedback is received that speed 3 is turned off (or the moment the command to turn off speed 3 is sent if the fancoil speed feedback is disabled) and the instant in which the command for turning on the new speed is sent; the parameter **"Speed 3 inertia time (seconds)"** is used to define the extent of the delay between turning off speed 3 and turning on the new speed. The values that can be set are:

- from **0 (default value)** to 10, with steps of 1

Defining the inertia times is useful for preserving the integrity of the fancoil, because the fact of turning off the power supply to the motor (turning off the actuator) of a fancoil speed does not guarantee that current is no longer circulating in the winding and the instantaneous supply of power to another winding could damage the fancoil (simultaneous powering of multiple windings).

The parameter **"Heating valve status feedback"** is used to enable the device to receive feedback from the actuator that commands the heating solenoid valve; in this way, the device is able to receive the telegram after the solenoid valve switched and to repeat the command if the switching did not take place. The values that can be set are:
- disable
- **enable (default value)**

Select **disable** to view the parameter **"Command repetition period with disabled feedback"**; select **enable** to view the communication object ***Heating valve status feedback*** (Data Point Type: 1.001 DPT_Switch).
When BUS voltage is restored, the device sends the read request command via the ***Heating valve status feedback*** object to be updated about the status of the heating solenoid valve.

With feedback enabled, after the device sends the switching command to the solenoid valve, it waits for one minute of its clock for the actuator to send the feedback that switching took place; if this does not take place, it sends the command again to the solenoid valve every minute until it receives the feedback of correct switching. It can happen that, during normal operation of the temperature adjustment, the actuator status can be changed by an entity external of the sensor, that forces its status, modifying it. In this case, the device repeats the valve switching command to realign the status of the actuator with the one determined by the control logic of the sensor, triggering the process for waiting for confirmation and repeating the command until the confirmation is received. In the same manner, if the control algorithm is operating in heating mode and feedback is received that the air cooling valve is activated, the algorithm is suspended immediately while the command for deactivating the air cooling solenoid valve is sent (triggering the process for waiting for confirmation and repeating the command until the confirmation is received) until the problem is resolved.

With the heating solenoid valve status feedback disabled, it may be useful to cyclically repeat the command to the actuator that manages the solenoid valve so that if the first command telegram is lost, one of the subsequent ones will be received eventually. The parameter **"Command repetition period with disabled feedback"** is used to define the time range of the cyclical sending; the values that can be set are:

- no repetition
- 1 minute
- 2 minutes
- 3 minutes
- 4 minutes
- **5 minutes (default value)**

If the control algorithm is fancoil, more important than the valve feedback is the possibility to receive feedback about the fancoil speed ON status. By enabling feedback, the device is always aware of the status of the speeds it commands; in fact, if within one minute from sending the command to the actuator that manages a certain speed it does not send confirmation that the command was performed to the sensor, it will send the command again every minute until correct confirmation is received from the actuator. As the system does not always have actuators dedicated to the fancoil with mechanically interlocked outputs, the logical interlock function must be implemented on a firmware level which makes it possible to turn on a fancoil speed that is different than what is on only if the correct feedback is received from the latter that it was turned off (providing speed feedback is enabled); as long as the sensor does not receive feedback that the active speed was turned off, it will not send the command to turn on the new speed to prevent multiple fancoil windings from being supplied with power at the same time, which would break the fancoil. The parameter **"Fancoil speed status feedback"** is used to enable the device to receive feedback from the actuator that commands the fancoil speeds. The values that can be set are:

- disable
- **enable (default value)**

Select **disable** to view the parameter **"Fancoil speed command repetition period"**; selecting **enable** displays the communication objects ***Heating fan V1 status feedback***, ***Heating fan V2 status feedback*** *and* ***Heating fan V3 status feedback*** (Data Point Type: 1.001 DPT_Switch).
When BUS voltage is restored, the device sends the read request command via the ***Heating fan V1 status feedback***, ***Heating fan V2 status feedback***, ***Heating fan V3 status feedback*** objects to be updated about the activation status of the fancoil speeds.
If the fancoil feedback is disabled, deactivation commands of the inactive speeds must be sent for every speed activation command; in the same manner, every speed deactivation command must be sent together with deactivation commands for the other speeds.

The parameter **"Fancoil speed command repetition period"** is used to define the time range of the cycling sending to the fancoil speeds; the values that can be set are:

- no repetition
- 1 minute
- 2 minutes
- 3 minutes
- 4 minutes
- **5 minutes (default value)**

By selecting any value other than **no repetition**, the commands are repeated on all speed communication objects.

6 "Air cooling" *menu*

The **Air cooling** menu contains the characteristic parameters of the load control algorithms for the air cooling system. The structure of the menu is as follows:

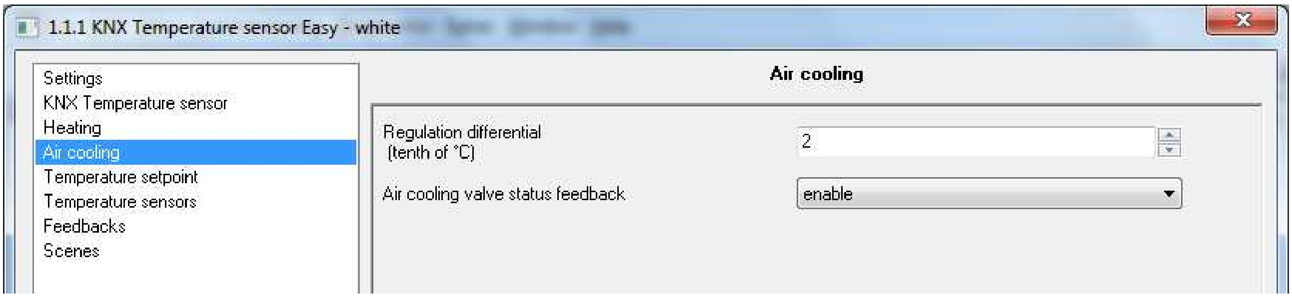


Fig. 6.1

6.1 Parameters

➢ *6.1.1 Regulation differential (tenth of °C)*

This is used to set the regulation differential value of the heating **2 points ON-OFF** or **2 points 0%-100%** control algorithm, already mentioned in the Control algorithms section, which, when subtracted from the value of the setpoint that was set, determines the threshold value below which the heating system is turned on in the 2 points control. The values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

➢ *6.1.2 Select air cooling system*

Used to automatically measure the operating parameters (Proportional band and Integration time) of the proportional integral algorithm based on the selected air cooling system. The values that can be set are:

- **ceiling air cooling (default value)**
- fan coil unit
- customised

Selecting **ceiling cooling**, the parameters **"Proportional band"** and **"Integration time (minutes)"** will be displayed but cannot be modified, and the values **5.0 °C** and **240** are displayed.
Selecting **fan coil unit**, the parameters **"Proportional band"** and **"Integration time (minutes)"** will be displayed but cannot be modified, and the values **4.0 °C** and **90** are displayed.
Selecting **customised**, the parameters **"Proportional band"** and **"Integration time (minutes)"** will be displayed but cannot be modified.
It is not necessary to store the parameter **"Select air cooling system"** in the memory.

The parameter **"Proportional band"** is used to set the width of the PWM proportional band of the air cooling **PWM proportional integral** control algorithm, already mentioned in the Control algorithms paragraph which, when added to the value of the setpoint that was set, determines the upper limit of the proportional band used for the proportional integral control. The values that can be set are:

- 1.0 °C
- 1.5 °C
- **2.0 °C** **(default value)**
- 2.5 °C
- 3.0 °C
- 3.5 °C

- 4.0 °C
- 4.5 °C
- 5.0 °C
- 5.5 °C
- 6.0 °C
- 6.5 °C
- 7.0 °C
- 7.5 °C
- 8.0 °C
- 8.5 °C
- 9.0 °C
- 9.5 °C
- 10.0°C

The parameter **"Integration time (minutes)"** is used to set the contribution of the integral action in the proportional integral control (see the Control algorithms paragraph). The values that can be set are:

- from 1 minute to 250 minutes with steps of 1 plus the value "no integral" (255), **60 (default value)**

Selecting **no integral**, the integral component is zero and the pure effect of proportional control is obtained.

The parameter **"Cycle time"** is used to set the value of the period within which the device carries out PWM modulation, modifying the duty-cycle. The values that can be set are:
- 5 minutes
- 10 minutes
- 15 minutes
- **20 minutes (default value)**
- 30 minutes
- 40 minutes
- 50 minutes
- 60 minutes

If the control algorithm is fancoil, the format of the air cooling solenoid valve commands (4-way system) is independent of that of the fancoil speed control; the solenoid valve control logic when the selected algorithm is fancoil is **2 points ON-OFF**. Via the communication object ***Air cooling valve switching*** (Data Point Type: 1.001 DPT_Switch) the device sends the command telegrams to the air cooling solenoid valve.

The parameter **"Valve regulation differential (tenth of °C)"** is used to set the regulation differential value of the 2 points control of the fancoil operating solenoid valve, as mentioned in the Control algorithms paragraph. The values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

The parameter **"Speed 1 regulation differential (tenth of °C)"** is used to set the value of the regulation differential of the first speed of the air cooling control algorithm **fancoil with ON-OFF speed control** or **fancoil with continuous speed control**, already mentioned in the Control algorithms paragraph; this value, added to the value "setpoint+ΔT_{valv}" determines the value of the threshold,under which speed 1 of the fancoil is turned on. the values that can be set are:

- from 0 to 20 with steps of 1, **2 (default value)**

Setting the value **0** obtains the condition "$\Delta T_{1\ cool}=\Delta T_{valv}$" for which the value of the speed 1 activation threshold is "setpoint+ΔT_{valv}" and the off value is "setpoint".

The parameter **"Speed 2 regulation differential (tenth of °C)"** is used to set the value of the regulation differential of the second speed of the air cooling control algorithm **fancoil with ON-OFF speed control** or **fancoil with continuous speed control**, already mentioned in the Control algorithms paragraph; this value, subtracted from the value "setpoint+$\Delta T_{valv}+\Delta T_{1\ cool}$" determines the value of the threshold, under which speed 2 of the fancoil is turned on. the values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

The parameter **"Speed 3 regulation differential (tenth of ℃)"** is used to set the value of the regulation differential of the third speed of the air cooling control algorithm **fancoil with ON-OFF speed control** or **fancoil with continuous speed control**, already mentioned in the Control algorithms paragraph; this value, subtracted from the value "setpoint+ΔT_{valv}+$\Delta T_{1\ cool}$+$\Delta T_{2\ cool}$" determines the value of the threshold, under which speed 3 of the fancoil is turned on. the values that can be set are:

- from 1 to 20 with steps of 1, **2 (default value)**

When, according to the "fancoil with speed control" algorithm, the device must turn on any speed and speed 1 is on, a delay can be inserted between the moment in which feedback is received that speed 1 is turned off (or the moment the command to turn off speed 1 is sent if the fancoil speed feedback is disabled) and the instant in which the command for turning on the new speed is sent; the parameter **"Speed 1 inertia time (seconds)"** is used to define the extent of the delay between turning off speed 1 and turning on the new speed. the values that can be set are:

- from **0 (default value)** to 10, with steps of 1

When, according to the "fancoil with speed control" algorithm, the device must turn on any speed and speed 2 is on, a delay can be inserted between the moment in which feedback is received that speed 2 is turned off (or the moment the command to turn off speed 2 is sent if the fancoil speed feedback is disabled) and the instant in which the command for turning on the new speed is sent; the parameter **"Speed 2 inertia time (seconds)"** is used to define the extent of the delay between turning off speed 1 and turning on the new speed. the values that can be set are:

- from **0 (default value)** to 10, with steps of 1

When, according to the "fancoil with speed control" algorithm, the device must turn on any speed and speed 3 is on, a delay can be inserted between the moment in which feedback is received that speed 3 is turned off (or the moment the command to turn off speed 3 is sent if the fancoil speed feedback is disabled) and the instant in which the command for turning on the new speed is sent; the parameter **"Speed 3 inertia time (seconds)"** is used to define the extent of the delay between turning off speed 3 and turning on the new speed. The values that can be set are:

- from **0 (default value)** to 10, with steps of 1

The parameter **"Air cooling valve status feedback"** is used to enable the device to receive feedback from the actuator that commands the air cooling solenoid valve; in this way, the device is able to receive the telegram after the solenoid valve switched and to repeat the command if the switching did not take place. The values that can be set are:

- disable
- **enable (default value)**

Select **disable** to view the parameter **"Command repetition period with disabled feedback"**; select **enable** to view the communication object ***Air cooling valve status feedback*** (Data Point Type: 1.001 DPT_Switch).
When BUS voltage is restored, the device sends the read request command via the ***Air cooling valve status feedback*** object to be updated about the status of the air cooling solenoid valve.

With feedback enabled, after the device sends the switching command to the solenoid valve, it waits for one minute of its clock for the actuator to send the feedback that switching took place; if this does not take place, it sends the command again to the solenoid valve every minute until it receives the feedback of correct switching. It can happen that, during normal operation of the temperature adjustment, the actuator status can be changed by an entity external of the sensor, that forces its status, modifying it. In this case, the device repeats the valve switching command to realign the status of the actuator with the one determined by the control logic of the sensor, triggering the process for waiting for confirmation and repeating the command until the confirmation is received. In the same manner, if the control algorithm is operating in air cooling mode and feedback is received that the heating valve is activated, the algorithm is suspended immediately while the command for deactivating the heating solenoid valve is sent (triggering the process for waiting for confirmation and repeating the command until the confirmation is received) until the problem is resolved.

With the air cooling solenoid valve status feedback disabled, it may be useful to cyclically repeat the command to the actuator that manages the solenoid valve so that if the first command telegram is lost, one of the subsequent ones will be received eventually. The parameter **“Command repetition period with disabled feedback”** is used to define the time range of the cyclical sending; the values that can be set are:

- no repetition
- 1 minute
- 2 minutes
- 3 minutes
- 4 minutes
- **5 minutes (default value)**

If the control algorithm is fancoil, more important than the valve feedback is the possibility to receive feedback about the fancoil speed ON status. By enabling feedback, the device is always aware of the status of the speeds it commands; in fact, if within one minute from sending the command to the actuator that manages a certain speed it does not send confirmation that the command was performed to the sensor, it will send the command again every minute until correct confirmation is received from the actuator. As the system does not always have actuators dedicated to the fancoil with mechanically interlocked outputs, the logical interlock function must be implemented on a firmware level which makes it possible to turn on a fancoil speed that is different than what is on only if the correct feedback is received from the latter that it was turned off (providing speed feedback is enabled); as long as the sensor does not receive feedback that the active speed was turned off, it will not send the command to turn on the new speed to prevent multiple fancoil windings from being supplied with power at the same time, which would break the fancoil. The parameter **“Fancoil speed status feedback”** is used to enable the device to receive feedback from the actuator that commands the fancoil speeds. The values that can be set are:

- disable
- **enable (default value)**

Selecting **disable** displays the parameter **“Fancoil speed command repetition period”** and the communication objects ***Air cooling fan V1 status feedback***, ***Air cooling fan V2 status feedback*** *and* ***Air cooling fan V3 status feedback*** (Data Point Type: 1.001 DPT_Switch).
When BUS voltage is restored, the device sends the read request command via the ***Air cooling fan V1 status feedback***, ***Air cooling fan V2 status feedback***, ***Air cooling fan V3 status feedback*** objects to be updated about the activation status of the fancoil speeds.

The parameter **“Fancoil speed command repetition period”** is used to define the time range of the cycling sending to the fancoil speeds; the values that can be set are:

- no repetition
- 1 minute
- 2 minutes
- 3 minutes
- 4 minutes
- **5 minutes (default value)**

By selecting any value other than **no repetition**, the commands are repeated on all speed communication objects.

7 *"Temperature setpoint"* menu

The **Temperatures setpoint** menu contains the parameters used to configure the setpoint values of the various temperature adjustment modes of the two functioning types.
The structure of the menu is as follows:

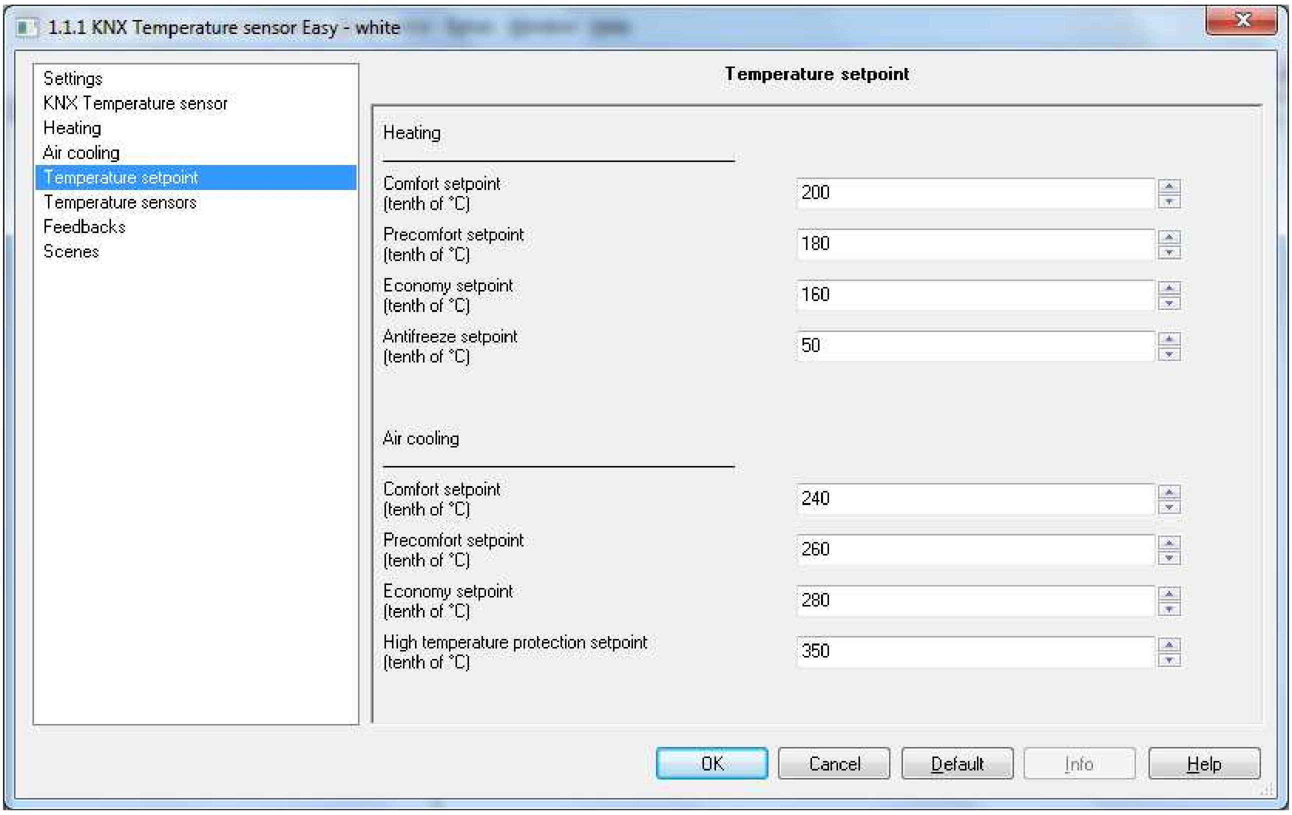


Fig. 7.1

7.1 Parameters

➢ *7.1.1 Heating section*

The parameter **"Comfort setpoint (tenth of °C)"** , which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the COMFORT mode for HEATING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **200 (default value)**

Remember that when setting this value, there is a constraint that it must be higher than the value set for the **"Precomfort setpoint (tenth of °C)"** for heating operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"Precomfort setpoint (tenth of °C)"** , which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the PRECOMFORT mode for HEATING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **180 (default value)**

Remember that when setting this value, there is a constraint that it must lie between the value set for the **"Comfort setpoint (tenth of °C)"** and the value set for the **"Economy setpoint (tenth of °C)"** for heating operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"Economy setpoint (tenth of °C)"** , which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the ECONOMY mode for HEATING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **160 (default value)**

Remember that when setting this value, there is a constraint that it must lie between the value set for the **"Precomfort setpoint (tenth of °C)"** and the value set for the **"Antifreeze setpoint (tenth of °C)"** for heating operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"Operating setpoint (tenth of °C)"** , which is visible if the remote control type is setpoint, is used to set the operating setpoint value for HEATING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **200 (default value)**

Remember that this value can be modified via the BUS telegram on the communication object assigned to it.

The parameter **"Antifreeze setpoint (tenth of °C)"** , which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the OFF mode for HEATING operation; the values that can be set are:

- from 20 to 70 with steps of 1, **50 (default value)**

Remember that when setting this value, there is a constraint that it must be lower than the value set for the **"Economy setpoint (tenth of °C)"** for heating operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"Antifreeze setpoint for window contact (tenth of °C)"**, which is visible if the remote control type is setpoint, is used to set the operating setpoint value for HEATING operation when the device is switched off from auxiliary input 1 with the window contact function; the values that can be set are:

- from 20 to 70 with steps of 1, **50 (default value)**

➢ *7.1.2 Air cooling section*

The parameter **"Comfort setpoint (tenth of °C)"** , which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the COMFORT mode for AIR COOLING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **240 (default value)**

Remember that when setting this value, there is a constraint that it must be lower than the value set for the **"Precomfort setpoint (tenth of °C)"** for air cooling operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"Precomfort setpoint (tenth of °C)"** , which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the PRECOMFORT mode for AIR COOLING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **260 (default value)**

Remember that when setting this value, there is a constraint that it must lie between the value set for the **"Comfort setpoint (tenth of °C)"** and the value set for the **"Economy setpoint (tenth of °C)"** for air cooling operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"Economy setpoint (tenth of °C)"** , which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the ECONOMY mode for AIR COOLING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **280 (default value)**

Remember that when setting this value, there is a constraint that it must lie between the value set for the **"Precomfort setpoint (tenth of °C)"** and the value set for the **"High temperature protection setpoint (tenth of °C)"** for air cooling operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"Operating setpoint (tenth of °C)"** , which is visible if the remote control type is setpoint, is used to set the operating setpoint value for AIR COOLING operation; the values that can be set are:

- from 50 to 400 with steps of 1, **240 (default value)**

Remember that this value can be modified via the BUS telegram on the communication object assigned to it.

The parameter **"High temperature protection setpoint (tenth of °C) "**, which is visible if the remote control type is HVAC mode, is used to set the setpoint value of the OFF mode for AIR COOLING operation; the values that can be set are:

- from 300 to 400 with steps of 1, **350 (default value)**

Remember that when setting this value, there is a constraint that it must be higher than the value set for the **"Economy setpoint (tenth of °C)"** for air cooling operation.
Remember that this value cannot be changed once the application has been downloaded.

The parameter **"High temperature protection setpoint for window contact (tenth of °C)"** , which is visible if the remote control type is setpoint, is used to set the operating setpoint value for AIR COOLING operation when the device (in slave mode) is switched off manually by the user; the values that can be set are:

- from 300 to 400 with steps of 1, **350 (default value)**

8 *“Temperature sensors”* menu

The **Temperature sensors** menu contains the parameters used to configure the operation of the sensor inside the device and the potential NTC external sensor. The structure of the menu is as follows:

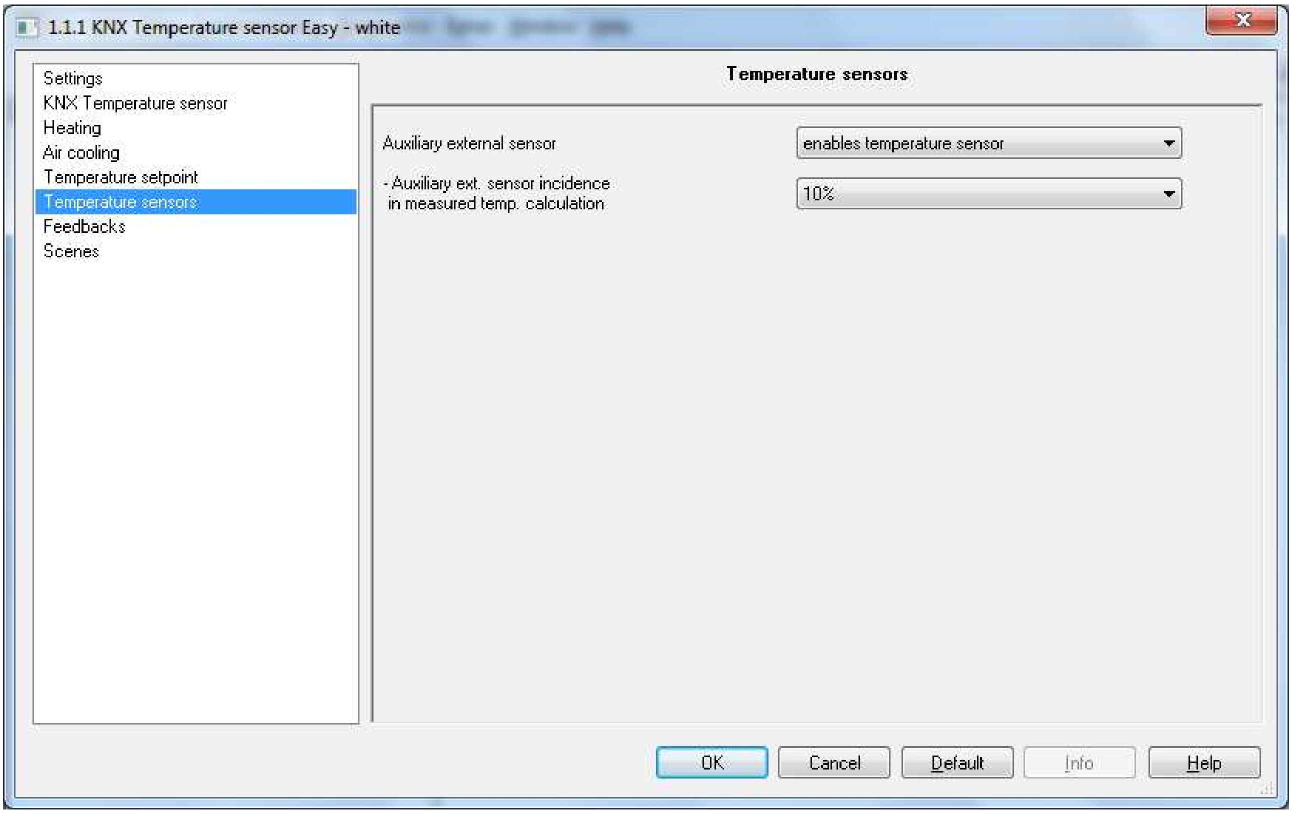


Fig. 8.1

8.1 Parameters

➢ *8.1.1 Auxiliary temperature sensor function*

This is used to configure the auxiliary sensor input to connect an NTC temperature sensor for measuring the room temperature or the floor temperature; the terminals of the auxiliary sensor input are used for this function. The values that can be set are:

- **disabled** **(default value)**
- enables temperature sensor
- enables underfloor sensor

Selecting **enables temperature sensor** displays the parameter **“Auxiliary ext. sensor incidence in measured temp. calculation”**.
Selecting **enables underfloor sensor** displays the parameter **“Temperature alarm threshold temperature (tenth of ℃)”** .

Once the auxiliary sensor input is enabled for the external temperature sensor, the measured temperature will not only be determined by the sensor on the device, but it will be determined by the weighted average between the value measured by the sensor on the device and the value measured by the NTC auxiliary external sensor. The parameter **“Auxiliary ext. sensor incidence in measured temp. calculation”** is used to determine the incidence of the value measured by the auxiliary external sensor when calculating the measured temperature, which ranges from a minimum of 10% to a maximum of 100% (external sensor measured value = measured temperature). The complete formula for the temperature calculation is:

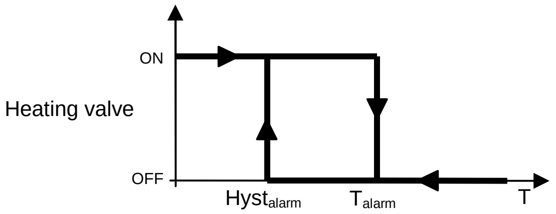
$T_{measured}$= + $T_{auxiliary\ external\ sensor}$ x $Incidence_{auxiliary\ external\ sensor}$+$T_{device\ sensor}$ x (100%-$Incidence_{auxiliary\ external\ sensor}$).
The parameter may assume the following values:

- from **10% (default value)** to 100% with step of 10%

If the external temperature sensor malfunctions, the contribution provided by the sensor is excluded from the calculation of the measured temperature (which then depends exclusively on the value measured by the device sensor).

The parameter **"Temperature alarm threshold temperature (tenth of °C)"** is used to define the floor limit temperature above which the device turns off the heating, as the temperature of the conduits is too high and could cause damage (temperature alarm); the floor temperature value is measured using the NTC sensor connected to the device on the contacts of the auxiliary sensor input. The values that can be set are:

- from 150 to 1000 with steps of 1, **500 (default value)**



The floor temperature alarm hysteresis threshold that, subtracted from the temperature alarm threshold determines the value under which the heating system is turned on again, is fixed and equal to 2 °C.
If the floor temperature sensor malfunctions, the temperature alarm is activated immediately (which stops once the floor sensor starts to operate normally).

9 "Feedbacks"*menu*

The **Feedbacks** menu contains the parameters used to set the conditions for sending the feedback that the device sends via BUS telegrams. The structure of the menu is as follows:

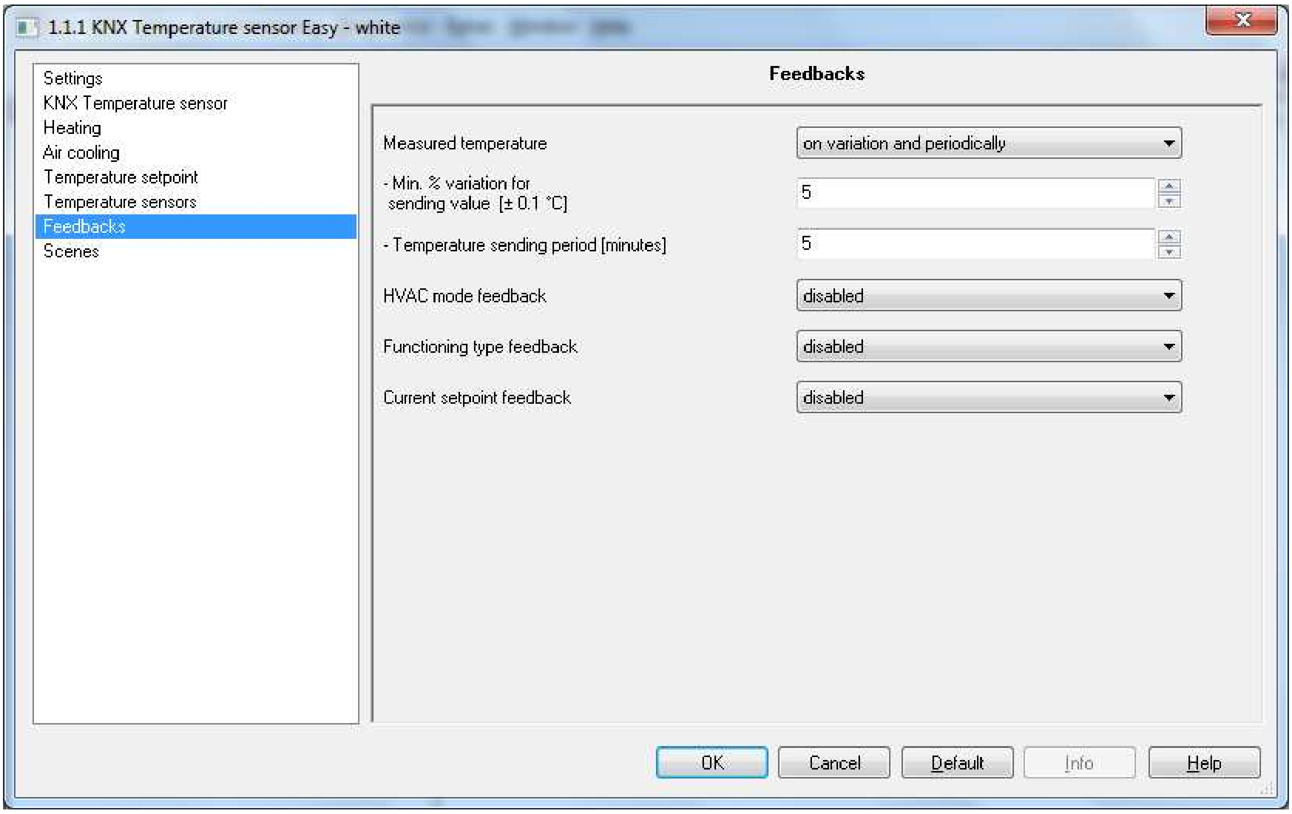


Fig. 9.1

9.1 Parameters

➢ *9.1.1 Measured temperature*

This is used to define the conditions for sending the value of the temperature measured by the device (which may or may not be influenced by the external sensor); the values that can be set are:

- **do not send (default value)**
- send only on demand
- send on variation
- send periodically
- send on variation and periodically

Selecting any value other than **do not send** displays the communication object ***Measured temperature*** (Data Point Type: 9.001 DPT_Temp). Selecting the value **send on variation** or **send on variation and periodically**, also the parameter **"Minimum temperature variation for sending value [± 0.1°C]"** will be visible, whereas by selecting **send periodically** or **send on variation and periodically** the parameter **"Temperature sending period [minutes]"** will be visible.
Selecting the value **send only on demand**, no new parameter will be enabled, as the temperature value is not sent spontaneously by the device; in the case of a status reading request, it sends the requester a telegram in response to the received command, which includes information about the measured temperature value.

The parameter **“Minimum temperature variation for sending value [± 0.1 °C]”**, which is visible if the temperature is sent due to a variation, is used to define the minimum temperature variation in comparison to the last sent temperature value, which generates the spontaneous sending of the new measured value; the values that can be set are:

- from 1 to 10 with steps of 1, **5 (default value)**

The parameter **“Temperature sending period [minutes]”**, which is visible if the temperature is sent periodically, is used to define the period with which the measured temperature feedback telegrams are sent spontaneously; the values that can be set are:

- from 1 to 255 with steps of 1, **5 (default value)**

➢ *9.1.2 HVAC mode feedback*

The parameter **“HVAC mode feedback”**, which is visible if the remote control type is HVAC mode, is used to enable and set the conditions for sending HVAC mode feedback via the communication object ***HVAC mode feedback*** (Data Point Type: 20.102 DPT_HVACMode). The values that can be set are:

- **disabled (default value)**
- send on demand only
- send on variation

Selecting **send on demand only** the HVAC mode feedback will not be sent spontaneously by the device via the communication object ***HVAC mode feedback***; in the case of a status reading request, it sends the requester a telegram in response to the received command, which includes information about the HVAC mode set on the device. Selecting **on variation**, the HVAC mode feedback will be sent spontaneously by the device via the communication object ***HVAC mode feedback*** each time the mode is changed.

➢ *9.1.3 Functioning type feedback*

This is used to enable and set the conditions for sending feedback about the set functioning type (Heating/Air cooling) by the device via the BUS telegram on the communication object ***Functioning type feedback*** (Data Point Type: 1.100 DPT_Heat/Cool). The values that can be set are:

- **disabled (default value)**
- send on demand only
- send on variation

Selecting **send on demand only** the feedback of the functioning type set on the device is not sent spontaneously by the device via the communication object ***Functioning type feedback***; in the case of a status reading request, it sends the requester a telegram in response to the received command, which includes information about the type of functioning set on the device. Selecting **on variation**, the feedback of the functioning type set on the device is sent spontaneously by the device via the communication object ***Functioning type feedback***, each time the functioning type changes.

➢ *9.1.4 Current setpoint feedback*

This is used to enable and set the conditions for sending the feedback regarding the set current setpoint value by the device via the BUS telegram on the communication object ***Current setpoint feedback*** (Data Point Type: 9.001 DPT_Temp). The values that can be set are:

- **disabled (default value)**
- send on demand only
- send on variation

Selecting **send on demand only**, the feedback regarding the active setpoint on the device is not sent spontaneously by the device via the communication object ***Current setpoint feedback***; in the case of a status reading request, it sends the requester a telegram in response to the received command, which includes information about the setpoint set on the device. Selecting **on variation**, the feedback regarding the active setpoint on the device is sent spontaneously by the device via the communication object ***Current setpoint feedback***, each time there is a change in the setpoint itself.

10 "*Scenes*" menu

The scene function is used to replicate a certain previously memorised condition upon receipt of the scene execution command. The structure of the menu is as follows:

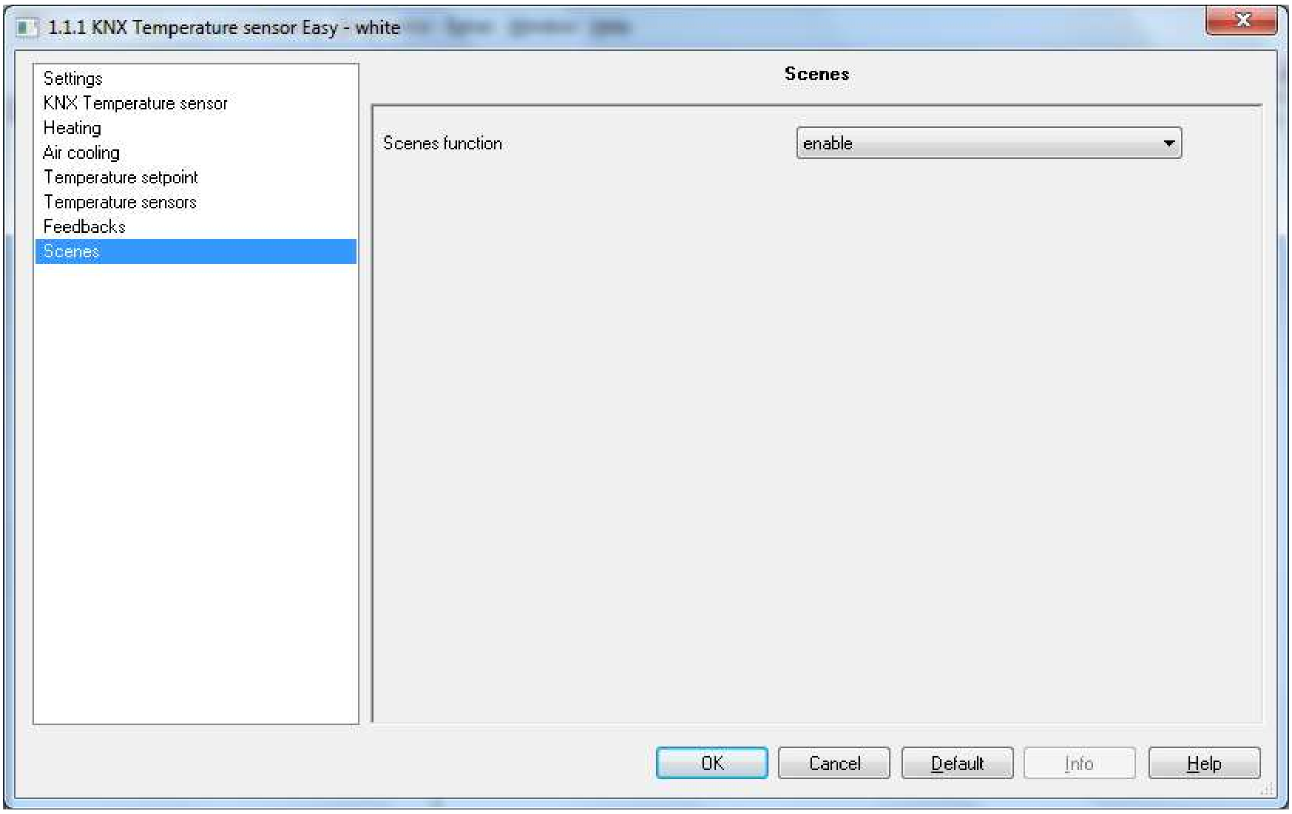


Fig. 10.1

10.1 Parameters

➢ 10.1.1 Scene function

This is used to activate and configure the function, displaying the various function configuration parameters and the relative communication object ***KNX sensor scene*** (Data Point Type: 18.001 DPT_SceneControl).
The scene function is used to send two possible commands to the device:

- execute scene, which is a command to assume a determined condition
- store scene, which is a command to memorise the current status (the moment the command is received) of the different functional parameters of the device defined in the configuration phase.

This function provides 8 scenes, for which the device can store/reproduce 8 different conditions of these functional parameters. The values that can be set are:

- **disable (default value)**
- enable

selecting **enable** displays the communication object ***KNX sensor scene*** through which the scene execution/storage telegrams are received.

The numerical value used to identify and as a result execute/store the scenes ranges from 0 (scene 1) to 7 (scene 8).
The sensor has various parameters that can change while functioning; those that are involved with the scene function are: HVAC mode (or operating setpoint) and functioning time.

11 Communication objects

By enabling all the functions available, all the associated communication objects will be made visible.

11.1 Communication object table

The following tables summarise all the communication objects with their specific ID numbers, names and functions displayed in ETS, plus a brief description of the function and the type of Datapoint used.

➢ 11.1.1 Communication objects with input functions

#	Object name	Object function	Description	Datapoint type
0	HVAC mode input	Auto/Eco/Precom/Comf/Off	Receives the HVAC mode setting commands	20.102 DPT_HVACMode
1	Window status input	1 = open/0 = closed	Receives the window contact status	1.019 DPT_Window_Door
2	KNX sensor scene	Execute/Store	Receives the KNX sensor function scene execution/store commands	18.001 DPT_SceneControl
3	Functioning type input	Heating/air cooling	Receives the functioning type setting commands	1.100 DPT_Heat/Cool
4	Setpoint input	Value ℃	Receives the operating setpoint values expressed in degrees Celsius	9.001 DPT_Temp
13	Heating valve status feedback	On/Off status	Receives feedback about the heating valve solenoid valve activation status	1.001 DPT_Switch
13	Heating/air cooling valve status feedback	On/Off status	Receives feedback about the heating/air cooling valve solenoid valve activation status	1.001 DPT_Switch
15	Air cooling valve status feedback	On/Off status	Receives feedback about the air cooling valve solenoid valve activation status	1.001 DPT_Switch
17	Heating fan V1 status feedback	On/Off status	Receives feedback about the heating fancoil speed 1 activation status	1.001 DPT_Switch
19	Heating fan V2 status feedback	On/Off status	Receives feedback about the heating fancoil 2 speed activation status	1.001 DPT_Switch
21	Heating fan V3 status feedback	On/Off status	Receives feedback about the heating fancoil 3 speed activation status	1.001 DPT_Switch
23	Air cooling fan V1 status feedback	On/Off status	Receives feedback about the air cooling 1 speed activation status	1.001 DPT_Switch
25	Air cooling fan V2 status feedback	On/Off status	Receives feedback about the air cooling 2 speed activation status	1.001 DPT_Switch
27	Air cooling fan V3 status feedback	On/Off status	Receives feedback about the air cooling 3 speed activation status	1.001 DPT_Switch

➢ *11.1.2 Communication objects with output functions*

#	Object name	Object function	Description	Datapoint type
5	HVAC mode feedback	Auto/Eco/Precom/Comf/ Off	Sends feedback about the set HVAC mode	20.102 DPT_HVACMode
6	Functioning type feedback	Heating/air cooling	Sends feedback about the set functioning type	1.100 DPT_Heat/Cool
7	Measured temperature	Value ℃	Sends the temperature values expressed in degrees Celsius calculated by the device	9.001 DPT_Temp
8	Current setpoint feedback	Value ℃	Sends the active setpoint values expressed in degrees Celsius	9.001 DPT_Temp
14	Heating valve switching	On/Off	Sends the heating solenoid valve on/off commands	1.001 DPT_Switch
14	Heating/air cooling valve switching	On/Off	Sends the heating/air cooling solenoid valve on/off commands	1.001 DPT_Switch
16	Air cooling valve switching	On/Off	Sends the air cooling solenoid valve on/off commands	1.001 DPT_Switch
18	Heating fan V1 switching	On/Off	Sends the heating fancoil speed 1 on/off commands	1.001 DPT_Switch
20	Heating fan V2 switching	On/Off	Sends the heating fancoil speed 2 on/off commands	1.001 DPT_Switch
22	Heating fan V3 switching	On/Off	Sends the heating fancoil speed 3 on/off commands	1.001 DPT_Switch
24	Air cooling fan V1 switching	On/Off	Sends the air cooling fancoil speed 1 on/off commands	1.001 DPT_Switch
26	Air cooling fan V2 switching	On/Off	Sends the air cooling fancoil speed 2 on/off commands	1.001 DPT_Switch
28	Air cooling fan V3 switching	On/Off	Sends the air cooling fancoil speed 3 on/off commands	1.001 DPT_Switch

12 ETS programming error feedback

The device is able to detect and therefore indicate various programming errors via the alternative flashing for 500 ms of the green LED and 500 ms of the red LED:
If multiple errors are detected, the error signalling (green/red flashing) will continue until the ETS application is downloaded again with the necessary corrections.

12.1 Error table

Possible errors
The constraints between the setpoints of the various HVAC modes belonging to the same functioning type are not respected: - $T_{anti\text{-}freeze} \leq T_{economy} \leq T_{precomfort} \leq T_{comfort}$ in heating mode - $T_{comfort} \leq T_{precomfort} \leq T_{economy} \leq T_{high\ temp.\ protection}$ in air cooling mode or if the control type is setpoint, the constraints are - $T_{antifreeze} \leq T_{operation}$ in heating mode - $T_{operation} \leq T_{high\ temp.\ protection}$ in air cooling mode The HVAC mode setpoints are out of the maximum range - The comfort/economy/precomfort setpoints are not between 5 °C and 40 °C - The antifreeze setpoint is not between 2 °C and 7 °C - The high temperature protection setpoint is not between 30 °C and 40 °C or if the control type is setpoint - The operating setpoint is not between 5 °C and 40 °C - The antifreeze setpoint is not between 2 °C and 7 °C - The high temperature protection setpoint is not between 30 °C and 40 °C Connection error of the communication objects dedicated to sending commands to the actuation devices (valves and fancoils): - if different control logic is enabled but command objects for the heating and air cooling solenoid valves are connected in the same group address - Coherency between the connection of the speeds from the fancoil. With regard to the command objects for 1 bit fancoil speeds, they can be linked to the same address or to different addresses, however it is important to maintain coherency between the pairs: if the two objects for controlling heating and air cooling speed 1 are linked to two addresses that are the same, also the pairs for speeds 2 and 3 must be the linked to two addresses that are the same. In this manner, if linked to two different addresses, also the pairs for speeds 2 and 3 must be linked to two different addresses. If a solenoid valve is connected (heating or air cooling), also the respective speeds must be connected, and vice versa. In common logic mode, and if connecting the heating fan speeds, they must also be connected for air cooling, and vice versa.