INWALL HVAC HOTEL ROOM THERMOSTAT

TM10DxxKNX

Technical Manual

Product:
TM10DxxKNX

Description:
INWALL HVAC HOTEL ROOM THERMOSTAT

Document
Version**:** **1.1**
Date:
12/09/2016

INDEX

1. Introduction 3
2. Product and functional overwiew 3
3. General Parameter Configuration 4
4. Temperature Sensor Function 4
5. Thermostat Function 5
6. Setpoint Settings 6
7. Function Buttons1 e 2 11
8. Two points ON/OFF 12
9. ON/OFF with PWM control 13
10. Fan coil on/off 14
11. Fan coil control % (or any generic continuous control) 16
12. Temperature probe failure / out of range measurement 16
13. Behavior of Thermostat on voltage failure, recovery and commissioning 17

Any information inside this manual can be changed without advice.

This handbook can be download freely from the website: *www.eelectron.com*

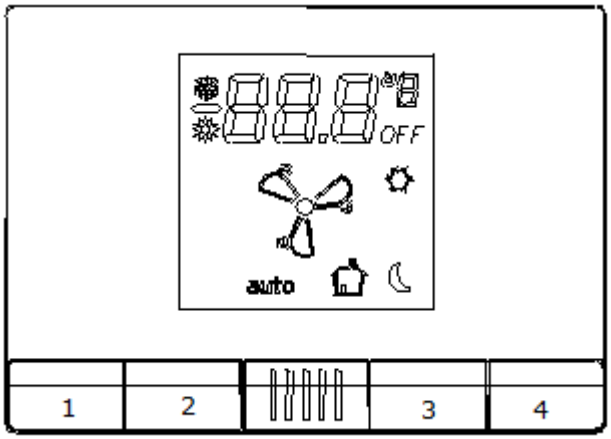
Exclusion of liability:
Despite checking that the contents of this document match the hardware and software, deviations cannot be completely excluded. We therefore cannot accept any liability for this.
Any necessary corrections will be incorporated into newer versions of this manual.

Symbol for relevant information 

Symbol for warning 

1. Introduction

This manual is intended to be used by installers and describes functions and parameters of the device TM10DxxKNX and how is possible to change settings and configurations using ETS software tool.



Numerazione dei tasti frontali

2. Product and functional overwiew

Configured as Temperature Sensor - main functions:

- 2 different temperature thresholds to trigger 1 bit telegrams alarm/warning
- Enable / disable of alarm / warnings via 1 bit object

Configured as Thermostat - main functions:

- Different control algorithms: 2 point on/off; PWM; Continuous Control / Fan Coil Control
- Different setting modes: via HVAC automatic / via HVAC Manual / via Setpoint
- Window contact function / forced comfort mode
- Additional external temperature sensors (optional)

Additional functions for 1 digital input and for front button (button 4 freely configurable)

- 1 bit commands: activation / deactivation commands (ON/OFF/TOGGLE) with short press or with differentiation of long and short press
- 1 byte commands (unsigned 0-255 or HVAC commands or value % commands).
- Sending of long action telegrams on the same address of short action or on a different group address
- Cyclic sending
- Sequences (3 commands mixing 1bit/1byte objects) with different group addresses
- Edges for 1 bit / 1 Byte / sequences
- Dimmer management (with single or double push-button)
- Blind / Roller Shutter management (with single or double push-button)
- Scene management

3. General Parameter Configuration

KNX PARAMETER	SETTINGS
Delay on Power-up	5 ÷ 15 sec
Through this parameter is possible to set the delay of transmission of telegrams after a power on by selecting the time by which the device is allowed to send telegrams. In large systems after a power failure or shutdown this delay avoids to generate excessive traffic on the bus, causing slow performance or a transmission block. If there are different devices requiring sending telegrams on the bus after a reset, these delays must be programmed to prevent traffic congestion during the initialization phase. The input detection and the values of objects are updated at the end of the transmission delay time At the end of ETS programming the device behaves like after a power on.	
Minimum time long press	0,3 sec 0,4 sec 0,5 sec 0,8 sec 1 sec 1,2 sec 1,5 sec 2 sec 3 sec 5 sec 8 sec 10 sec
Determines how long must be a press to be considered long; if shorter than the selected value the press will be considered short.	
Input debounce time	40 ms 80 ms 100 ms 150 ms 200 ms 600 ms 1 sec.
When a button connected to the input is pressed it is possible to have the contact opened or closed more than once before fixing into a stable position; this can be caused by a rapid succession of bounces between mechanicals contacts. For this reason it is important to determine a correct value of the parameter “debounce time” to avoid these bounces could be taken by the device as input switching. How this parameter works: after the device has detected a change of status for an input channel, it waits for a time equal to the time set as “debounce time” before updating the value of the corresponding data point. The input signal is not evaluated during this time.	

4. Temperature Sensor Function

The temperature probe allows a reading of the temperature within its range with resolution 0.1 ° C

KNX PARAMETER	SETTINGS
Temperature sensor calibration	-1,5°C ÷ +1.5°C with resolution, 0,1°C
It's possible to add an offset to the temperature value measured by the probe before it is sent on the bus or made available for reading.	

Temperature cyclic sending	Disable Enable
It's possible to enable the periodic sending of measured temperature value, if this option is disabled, reading can be done only on read-request.	
Sending interval	1 min, 5 min, 10 min, 15 min, 45 min, 30 min, 1 h, 4 h, 12 h, 24 h
If the periodic sending is enabled the sending interval is set by this parameter.	
Enable threshold T1 (low)	Disabilita abilita
You can also enable two thresholds for temperature and, for each thresholds, send a telegram of attention (of size 1 bit) whenever the measured temperature exceeds or falls below the threshold. For each threshold can be set whether to send the telegram "1" when the measured temperature "T" exceeds the threshold temperature "Tx" and then send the telegram "0" when the measured temperature "T" becomes less than the threshold temperature "Tx "or vice versa	
Enable threshold T2 (high)	Disable Enable
See description of "***Enable threshold T1 (low)***".	
Value threshold T1	-15°C ÷ +55°C
Value threshold T2	-15°C ÷ +55°C
Telegram to send when T < T1	Telegram "0" Telegram "1"
Telegram to send when T > T2	Telegram "0" Telegram "1"
Object enable for Trigger 1 and 2	Hide Show
It's 'possible to enable/disable the remote temperature sensor with a communication object. When this object is enabled and receives a telegram "1" the temperature probe is active and sends trigger telegrams according to thresholds T1 and T2 values; otherwise only temperature value is periodically sent.	
Initial value enable object	0 1
Allows to initialize enable object as active (1) or inactive (0) after power on, reset or download.	

5. Thermostat Function

The temperature sensor can be configured as a thermostat to control the temperature of a room or area by driving heating or cooling equipment / air conditioning fan coils / valves or through commands on / off to heating /cooling elements such as radiators, heat pumps, split, etc. ..

- The thermostat operates temperature in a range from -50 ° C to + 100 ° C with 0.1 ° resolution.
- Setpoint values sent to the device on the bus are accepted in a range 10°C to 50°C
- Setpoint accepted in SETPOINT MODE are in a range from 0°C to 50 °C

KNX PARAMETER	SETTINGS
Display mode	Actual temperature Actual setpoint
The display shows on the main page the current setpoint or the temperature measured	
Use thermostat ro control fan coils	Yes No
Choose “YES” to display objects intended to manage fan-coil with 1-2-3 speeds and 2 or 4 tubes in 1-bit mode or continuous control 1 byte mode	
Value of Heat/Cool object after download	Selects the heating or cooling mode after download
Value of HVAC mode object after download	Selects the HVAC mode after download
Control type when confort ends	Last value received HVAC Stand by Economy
It specifies which status is active when 1 bit comfort is deactivated	
Function buttons 1-2	Disabled (only setpoint visualization) Change setpoint adjustment Change setpoint absolute
It defines the function associated with the buttons 1 and 2; They can disabled or can change the value of setpoint adjustment (± 1, ± 2, etc ..) or permit the change of the absolute value of the setpoint.	
Window Contact	Disabled Enabled
Shows or hides communication object “window contact”	
Thermostat OFF object	Disabled Enabled
Shows or hides the communication object that allows to set thermostat in OFF; when the thermostat is OFF it does not make any adjustment, even frost protection or the high temperature protection are disabled.	

6. Setpoint Settings

The control setpoint can be changed by bus in two different ways, via one of these objects:

- HVAC Mode
- SETPOINT Mode

The right policy to adopt depend from the device that acts as a master, a time thermostat, a control panel or a SW supervisor

SETPOINT MODE object

When "Thermostat control mode" parameter is selected with the value SETPOINT MODE, object HVAC Mode is no longer visible.
Each time the thermostat receives a value on object SETPOINT MODE (2 byte size), it is used as setpoint for temperature control.

HVAC MODE object (switched heat / cool)

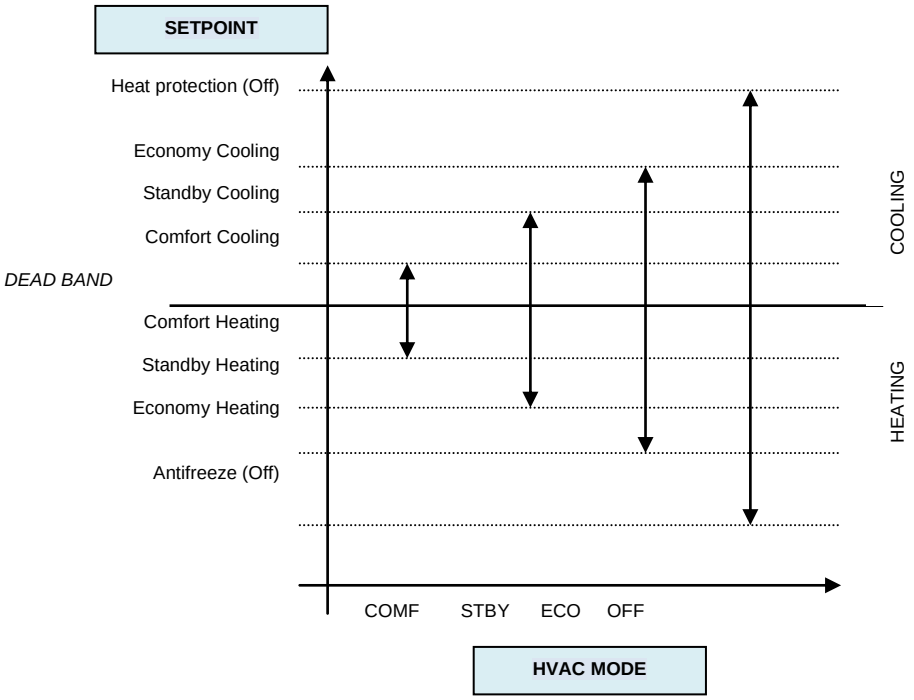
Using the object HVAC MODE (1 byte size), you can set the thermostat in one of the following modes: BUILDING PROTECTION; ECONOMY; STANDBY; COMFORT; each mode is associated with a setpoint set by a ETS parameter.

BUILDING PROTECTION mode is associate to setpoint antifreeze in heating mode and high temperature protection in cooling mode.

HVAC MODE object (automatic heat / cool)

Behaviour for this value of parameter “Thermostat control mode” is the same as above described but the switching from heating to cooling mode and vice versa is automatic. With this setting it is necessary to set an insensitive zone as in parameter “Dead zone”.

Whenever temperature becomes greater than :
Setpoint comfort heating + (Dead Band / 2) active control is cooling; when temperature becomes less than: ***Setpoint comfort cooling - (Dead Band / 2)*** active control is heating.



SETPOINT COMFORT object
SETPOINT STANDBY object
SETPOINT ECONOMY object

These 2 byte objects are used to set the setpoint values for COMFORT, STAND-BY, ECONOMY mode.
Whenever change, the setpoint are in saved in memory.
After download these setpoint are reset to values according to ETS parameter; on power up these object are set according to last values before power down.

- Use these communication objects to change current setpoint for every HVAC Mode according to the current active control (heating or cooling)

SETPOINT OBJECTS	
Telegram received on:	**Setpoint changed:**
COMFORT (OBJ # 31)	Setpoint comfort heating
STANDBY (OBJ # 30)	Setpoint standby heating
ECONOMY (OBJ # 29)	Setpoint economy heating
COMFORT (OBJ # 32)	Setpoint comfort cooling
STANDBY (OBJ # 33)	Setpoint standby cooling
ECONOMY (OBJ # 34)	Setpoint economy cooling

COMFORT object

COMFORT object (1 bit size) is visible only when "Thermostat control mode" parameter is selected with the value HVAC MODE.
When a telegram "1" is received thermostat goes in COMFORT mode (it applies for both heating and cooling)
On receipt of a telegram "0", thermostat returns to the mode set by HVAC MODE object.
COMFORT mode can be set also with timing: after a time set by a parameter thermostat returns in the previous mode.

KNX PARAMETER	SETTINGS
Comfort Object	Time limited Time unlimited
Comfort Overwrite Time	1.. 255 (minutes)
Comfort Object priority	Yes No
It defines if the object comfort 1-bit has priority respect object HVAC or not, if you define a priority then all settings are stored on the object HVACwhen received but not implemented until 1 bit comfort object is deactivated.	

WINDOW CONTACT object

This object, if enabled, has higher priority than HVAC MODE, SETPOINT MODE, COMFORT objects.
When a telegram is received ("0" or "1") on the communication object WINDOW CONTACT thermostat enters a power saving mode:

- BUILDING PROTECTION (if running in HVAC MODE)
- Setpoint antifreeze / high temperature protection (if running in SETPOINT MODE)

If the telegram received indicates that the window is opened thermostat change its mode or setpoint after 1 minute from the reception of the telegram.
When it receive a telegram corresponding to state “window closed” it restores the previous mode, always with a delay of 1 minute . The value of SETPOINT ADJUSTMENT (if enabled) is always restored.

SETPOINT ADJUSTMENT object

The object SETPOINT ADJUSTMENT allows you to temporarily change the setpoint value used by the thermostat applying an offset to the current value.
If the thermostat is operating in "HVAC MODE" the offset value is applied from the time of receipt of a valid telegram on object SETPOINT ADJUSTMENT until this value does not change, even in case of change of the active mode (Comfort and Standby only); this does not happen with regard to Economy mode and Building Protection: in this modes the value of object SETPOINT ADJUSTMENT is forced to 0.
Similarly, if the thermostat is operating in SETPOINT MODE the offset value is applied also when the setpoint value received on this object changes.

ADDITIONAL TEMPERATURE object

It is possible to enable the reading of a second external probe which sends the measurement data to the thermostat via the communication object ADDITIONAL TEMPERATURE of size 2 bytes.

KNX PARAMETER	SETTINGS
Ratio between internal and additional sensor	90 % internal–10 % external 80 % internal–20 % external 70 % internal–30 % external 60 % internal–40 % external 50 % internal–50 % external 40 % internal–60 % external 30 % internal–70 % external 20 % internal–80 % external 10 % internal–90 % external Additional sensor only
This parameter set the “weight” to assign to internal and additional temperature;	
Surveillance time for additional sensor	10..255 (min)
Whenever the thermostat receive a valid data from additional temperature sensor it consider this value in the calculation of the measured temperature and reset the internal time (monitoring time), if the surveillance time expires without receiving any valid data thermostat start considering only the internal probe (at 100%) until it receives a new valid data. (see paragraph 0 “Logic and parameters are the same used in On/off with PWM control mode; the difference is that now the proportional value is sent to the bus via a 1 byte object format as a % value from 0% to 100%. This mode is useful to control fan coils (selecting 2 or 4 pipes) or generic proportional actuators as valve drivers only linking the 1 byte communication object and avoiding to link the valve objects.	

CONTINUOUS CONTROL object

This 1 Byte object send % control value to actuator.

SET MAN/AUTO MODE object

SET MAN/AUTO MODE Objects is a CO for changing the calculation mode for CONTINUOUS CONTROL object; in AUTO Mode the calculation is carried out via a proportional algorithm (Δ temperature between actual temp. and Setpoint Temp) and a integral correction (Cycle Time); in MAN mode the output value control is set by the value send to the object FORCE VALUE IN MANUAL MODE object.

")

- If external probe is enabled the monitoring time is used to check if the additional temperature sensor periodically sends valid data to the thermostat. This mechanism avoids to consider as valid some data which can be old hours or days, for example if the additional sensor should fail or the thermostat could not receive data for long time.
- It is strongly recommended to set a value for surveillance time of the additional sensor more than twice of the period set for the cyclical sending of the additional sensor.
- If the external probe is weighted at 100% (Parameter Ratio between internal and external = external sensor only) then when the monitoring time expires the thermostat switch off all controlled loads until the reception of a valid telegram

ACTUAL SETPOINT object

The ACTUAL SETPOINT object send the setpoint in use and is sent every time:

- The value of HVAC mode object changes
- The value BASE SETPOINT changes
- The value of SETPOINT ADJUSTMENT object changes
- After download
- One minute after power on

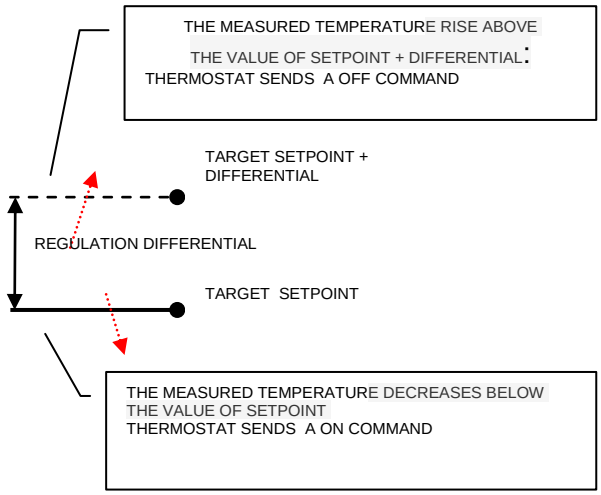
7. Function Buttons1 e 2

The behavior associated with the buttons 1 and 2 depends strongly on the type of Control Mode chosen for the thermostat: refer to the following scheme:

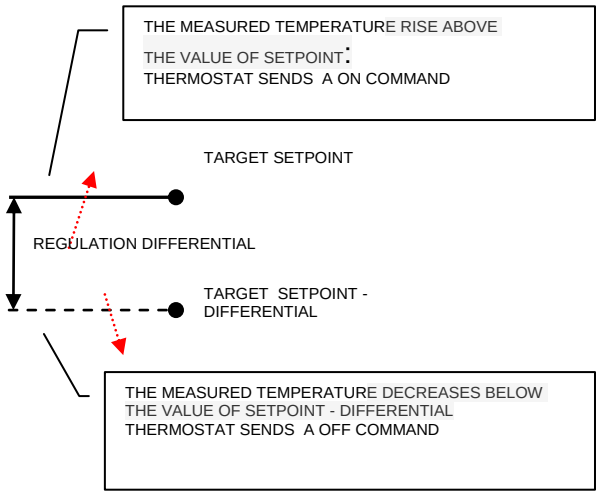
<table>
<tr><td rowspan="3">Function Buttons 1-2</td><td colspan="4">Thermostat control mode</td></tr>
<tr><td colspan="2">HVAC switched</td><td>HVAC Automatic</td><td>Setpoint</td></tr>
<tr><td>Change Setpoint Adjustment</td><td colspan="2">Settings via the buttons 1 and 2 chenge the value of "Setpoint Adjustment" within the limits allowed by the parameter "adjustment allowed". This change is added or substracted to the setpoint of standby and comfort; it is forced to zero when it enters in economy mode</td><td>Settings via the buttons 1 and 2 change the value of "Setpoint Adjustment " within the limits allowed by the parameter "adjustment allowed".</td></tr>
<tr><td>Change Absolute Setpoint</td><td>Settings via the buttons 1 and 2 change only the current setpoint within the limits allowed by the parameter "adjustment allowed"</td><td>Settings via the buttons 1 and 2 change the actual (current) setpoint and determine the recalculation of the other setpoints: comfort, standby and economy in summer and in the winter in order to maintain the differences between them and keep the correct the value of the dead band</td><td>Settings via the buttons 1 and 2 change the actual (current) setpoint regardless of the value of the other setpoint in summer or winter</td></tr>
</table>

8. Two points ON/OFF

Control algorithm “2 points on / off” is used to control heating or cooling elements that can be controlled by switching on and off of the same elements, radiators, underfloor heating with on-off valves, boilers, etc. ..
When the thermostat switches to "winter mode" (heat mode) sends a off command on object ON/OFF COOLING and operates the control only through the object ON/OFF HEATING (the object ON/OFF COOLING is therefore not updated anymore until it returns in "cooling mode").
Therefore in the transition from " winter" to "summer” mode sends a off command on ON/OFF HEATING commands and activates the control through the object ON/OFF COOLING.
:



Controllo ON/OFF in modalità raffrescamento:



9. ON/OFF with PWM control

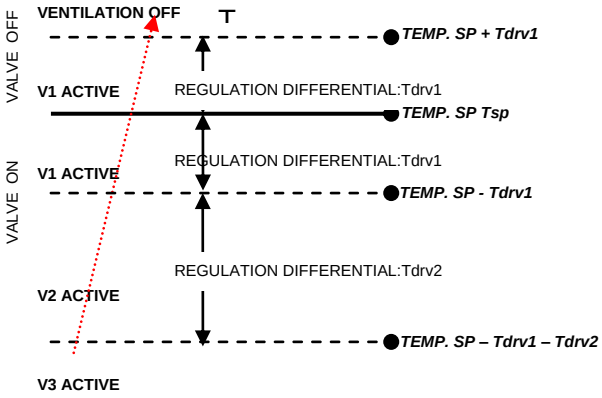
On/off with PWM control is an algorithm that reduces the effects of hysteresis around the set point value by adjusting the controls on the values ranging from 0% to 100% where 0% means “control off” and 100% means “maximum control action”.
Once a cycle time is defined the thermostat sets the actuator to ON for a fraction of the cycle time and OFF for the remaining part. Driving the actuator with the control value of 80% means that it is active (i.e., ON) for 80% of cycle time and OFF for the remaining 20%.

KNX PARAMETER	SETTINGS
Cycle time (TCp)	10, 20, 30, 60 min
It defines the time interval.	
Proportional band (Bp)	0.8, 1.2, 1.6, 2.0 °C
The proportional band BP is a range of temperatures between “Setpoint” and “Setpoint-Bp” in heating mode and between “Setpoint” and “Setpoint+Bp” in cooling mode, within this interval thermostat controls the temperature using the proportional algorithm; outside It drives actuator always in ON or OFF. When temperature is inside this range device wait the end of the cycle time before calculating the duty cycle of the next cycle. When temperature is outside of this range : below “Setpoint-Bp” in heating mode or above “Setpoint+Bp” in cooling mode it starts a new cycle as soon as temperature enters the Bp	
Integration time	5 .. 250 min
Time considered for the calculation of the integral component	

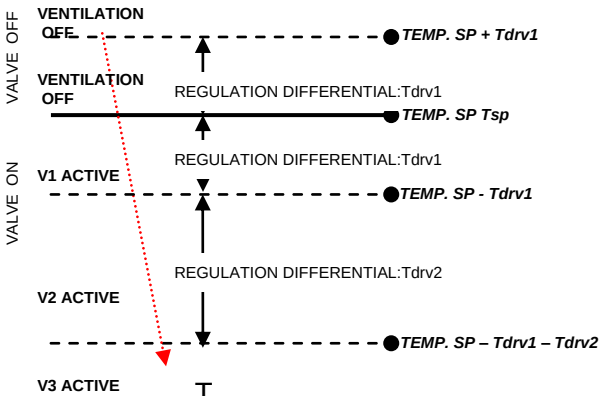
10.Fan coil on/off

Fan coil is a device that controls the flow of cooling / heating liquid driving a valve (2-pipe fan coil) or two valves (4-pipe fan coil).
Liquid exchanges heat/cool with the environment through a ventilation system controlled by a fan. The fan is driven by an engine that typically has 3 windings that can be enabled at 3 distinct speeds.

Control logic for a 3 speed fan coil in heating:
When temperature increasing



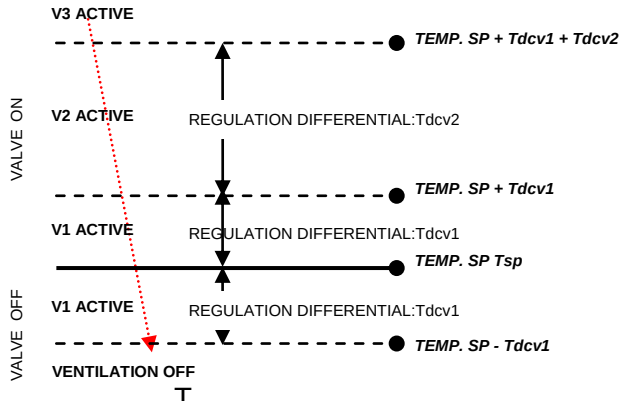
When temperature decreasing



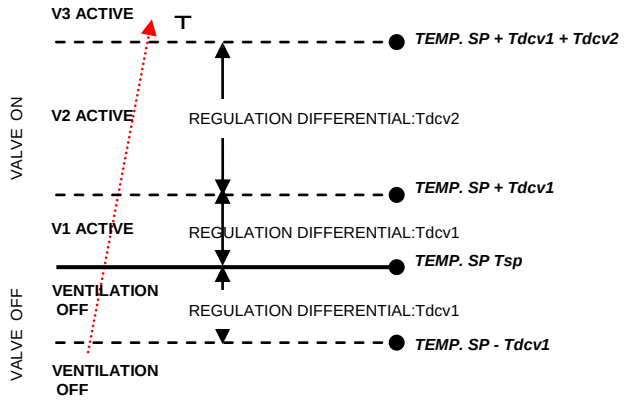
Where:

Tsp : Target setpoint temperature
T_{drv1} : regulation differential in heating for V1 Speed
T_{drv2} : regulation differential in heating for V2 Speed
T_m : Actual measured temperature

Control logic for a 3 speed fan coil in cooling:
When temperature decreasing



When temperature increasing



Where:

Tsp : Target setpoint temperature
Tdcv1 : regulation differential in cooling for V1 Speed
Tdcv2 : regulation differential in cooling for V2 Speed
T_m : Actual measured temperature

11. Fan coil control % (or any generic continuous control)

Logic and parameters are the same used in On/off with PWM control mode; the difference is that now the proportional value is sent to the bus via a 1 byte object format as a % value from 0% to 100%.

This mode is useful to control fan coils (selecting 2 or 4 pipes) or generic proportional actuators as valve drivers only linking the 1 byte communication object and avoiding to link the valve objects.

CONTINUOUS CONTROL object

This 1 Byte object send % control value to actuator.

SET MAN/AUTO MODE object

SET MAN/AUTO MODE Objects is a CO for changing the calculation mode for CONTINUOUS CONTROL object; in AUTO Mode the calculation is carried out via a proportional algorithm (Δ temperature between actual temp. and Setpoint Temp) and a integral correction (Cycle Time); in MAN mode the output value control is set by the value send to the object FORCE VALUE IN MANUAL MODE object.

12. Temperature probe failure / out of range measurement

- If the temperature probe is disconnected or in short circuit the control action is interrupted and the controlled actuators are switched off.
- **The value of temperature sent on the bus in case of probe disconnection or short circuit or for out of range measured value is 0 °C (according to KNX DPT_Value_Temp 9.001)**

TEMPERATURE SENSOR ALARM object

In event of temperature probe failure / out of range measurement a telegram from 1 bit communication object - obj #39: “Temperature sensor alarm” - is sent on the bus with value 1. As soon the temperature sensor works good again a value “0” is transmitted.

To correctly manage the use of internal and/or additional refers to the following possible configuration modes:

CONFIGURATION MODE 1	
Internal probe	Connected
Additional probe	Disabled
Ratio between probes	NA. (100% internal)

Measure of temperature is performed every 60 seconds; if the temperature probe is disconnected or in short circuit the control action is interrupted and the controlled actuators are switched off.

probe disconnection / short circuit / out of range measurement:

Obj #21 “Actual temperature” transmits 0 °C
Obj #39 “Temperature sensor alarm transmits “1”

CONFIGURATION MODE 2	
Internal probe	Connected
Additional probe	Received by bus
Ratio between probes	10 % to 90%

Measure of internal temperature is performed every 60 seconds; the additional temperature is read every 60 considering last value received on Obj #22 “Additional temperature”.

The value of temperature sent on the bus is the pounded average between internal and additional probes value.

If the additional temperature is out of range or the surveillance time expires without any message received, thermostat start considering only the internal probe until it receives a new valid value from the additional probe; in this case the additional value is taken in count again.

Anyway, if the internal temperature is out of range or probe is disconnected / short circuit then the control action is interrupted and the controlled actuators are switched off:

Obj #21 “Actual temperature” transmits 0 °C regardless the value received from additional sensor.
Obj #39 “Temperature sensor alarm transmits “1”

When internal probe starts again to measure a “in-range” value thermostat start again its control action.

CONFIGURATION MODE 3	
Internal probe	Not connected
Additional probe	Connected or by bus
Ratio between probes	100% external

If the additional temperature is out of range or the surveillance time expires without any message received, thermostat stops the control action and the controlled actuators are switched off.

If internal probe is anyway connected (but not used until additional probe is working good) then in event of failure of the additional probe the internal probe is used (see behaviour of configuration mode 1).

When additional probe begin to measure a “in-range” value thermostat start again its control action and return to consider the additional probe.

13. Behavior of Thermostat on voltage failure, recovery and commissioning

Behavior on bus voltage failure

On failure of bus voltage no actions are executed by the device; behavior of controlled actuators must be set using their own parameters.

Behavior on bus voltage recovery

On bus voltage recovery all the communication objects are set to 0 except for objects for which a parameter is defined for the initial value.
Thermostat keeps these values in memory and restore them after recovery:

- Heat / Cool mode (if enabled)

- HVAC Mode (if enabled)
- Base Setpoint (if enabled)
- Force value in manual mode (if enabled)

Control values (i.e. commands to actuators) are calculated on the base of actual setpoint and measured temperature.

- After power on device recalculates the commands to actuators and switch them on, if necessary, otherwise does not carry out any action; you are recommended to set the behavior of actuator in order to switch the heating / cooling equipment off after bus power on.

Behaviour on commissioning (ETS Download)

After download it is possible to set initial value of:
- Heat / Cool mode (if enabled)
- HVAC Mode (if enabled)

For other communications objects the behavior is identical to bus voltage recovery.

Wrong application download

If the wrong ETS application is downloaded then KNX/EIB led starts blinking and device is not operative on the bus. A power reset must be done and the correct ETS application must be downloaded.