

Presence Sensor

User manual edition: [3.0]_a

www.zennio.com

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DOCUMENT UPDATES

Version	Changes	Page(s)
[3.0]_a	Changes in the application program: <ul style="list-style-type: none">• Internal optimisation.	-
[2.0]_a	Changes in the application program: <ul style="list-style-type: none">• Improved detection algorithm and changes in the datapoint type of some objects.	-
[1.0]_a	Changes in the application program: <ul style="list-style-type: none">• Luminosity measurement in percentage for certain devices.	-

1 INTRODUCTION

A variety of Zennio devices feature a module for **presence and/or luminosity sensor** management, which allow receiver and **monitor ambient light**, as well as **managing channels of presence, constant light control** and **occupancy presence**.

This module does not require connecting any accessories to the device inputs as it is based on the measurement of an internal sensor, although it is also possible to receive and manage information from other sensors or devices.

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

1.1 START-UP AND POWER LOSS

After download or device reset, the presence sensor module requires a time for calibration. During this time no movements can be detected. Please refer to the **device user manual** to check the time required.

Depending on the configuration, some specific actions will also be performed during the start-up. For example, the integrator can set whether the detection channels should start up enabled or disabled. Please consult the next sections of this document for further details.

2 CONFIGURATION

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

2.1 CONFIGURATION

In the “Configuration” tab, up six independent presence detection channels, two more for constant light control and one for occupancy detection can be enabled for later configuration.

- **Presence detection** consists in sending objects to the bus whenever the device observes a moving body (or no longer observes it) in the environment of the room where it has been installed.
- **Constant light control** consists in sending KNX orders to the dimmer device that controls the in-room luminaries so the ambient light level remains constant even if other light sources are present.
- **Occupancy detection** is an algorithm that allows determining, through a multiple sensor configuration, whether a particular space is under occupation no matter if the occupant moves or not (i.e., no matter if the device is detecting presence in the room or not).

The general configuration of the presence detection system allows enabling or disabling each of these channels.

It also allows setting different luminosity setpoints or object types for **daytime and night time** as well as activating or deactivating the **motion indicator LEDs**.

On the other hand, the presence sensor module allows measuring the **luminosity** in the roomy and, among other functions, sending the value to the KNX bus. Depending on the type of device in which this functional module will be incorporated, luminosity will be measured in luxes or in percentage. In addition, for devices where luminosity is measured in luxes it is possible to apply certain correction parameters in order to compensate some factors that may distort the measurements obtained by the sensor.

To that end, two variables are defined:

- **Correction Factor:** ratio between the measured luminosity and the actual luminosity.
- **Offset:** deviation between measured and actual luminosities that remains constant.

In this way, the resulting luminosity is:

$$L = F \cdot L_S + O$$

Where L is the luminosity sent to the bus, F the correction factor, L_S the luminosity measured by the sensor and O the offset.

Example:

- **Correction factor** = 0.5
- **Offset** = 100 luxes
- **Luminosity sent to the bus** = $100 + (0.5 * \text{Luminosity measured by the sensor})$.

Note: to obtain the above values, it is advisable to compare the measurements of both a device that incorporates the presence sensor module installed on the ceiling and a luxmeter on the work surface, i.e., the surface where the actual luminosity is required to be monitored. In case there are light sources of different types within the facility, it is advisable to perform this calculation for each of them and afterwards obtain the average values. For further details, please refer to the documentation available at www.zennio.com.

Finally, it is also possible to set custom **sensitivity** values for the motion sensors and to perform certain adjustments regarding the luminosity measurement. Factors such as the motion speed and direction together with the distance to the device may have a positive or negative effect the motion detection.

Distance		Speed		Direction	
Longer	Shorter	Greater	Lower	Front	Tangential
Negative	Positive	Positive	Negative	Negative	Positive

Table 1. Factors conditioning the motion detection

Therefore, **low sensitivity** may prevent the detection of slower and front movements, especially at longer distances from the sensor. On the other hand, **higher sensitivity** may saturate the detection, especially at shorter distances.

The presence sensor module allows configuring the sensitivity of each of the motion sensors (one per detection sector) independently.

ETS PARAMETERISATION

From the Configuration tab, it is possible to enable or disable the different functions from presence sensor module related to the motion detection, to the luminosity measurement and to the sensors sensitivity.

General	Lens Type	<input checked="" type="radio"/> White <input type="radio"/> Black	
Presence Detector	Channel 1	<input type="checkbox"/>	
	Channel 2	<input type="checkbox"/>	
	Channel 3	<input type="checkbox"/>	
	Channel 4	<input type="checkbox"/>	
	Channel 5	<input type="checkbox"/>	
	Channel 6	<input type="checkbox"/>	
	Constant Lighting Control 1	<input type="checkbox"/>	
	Constant Lighting Control 2	<input type="checkbox"/>	
	Occupancy Detection	<input type="checkbox"/>	
	Day/Night	<input type="checkbox"/>	
	Detection LEDs	<input type="radio"/> Disabled <input checked="" type="radio"/> Enabled	
	LUMINOSITY		
	Internal Sensor		
Correction Factor	<input type="text" value="10"/>	x 0.1	
Offset	<input type="text" value="0"/>	lux	
Luminosity Correction Objects	<input type="checkbox"/>		
Luminosity Sending	<input type="checkbox"/>		
SENSITIVITY			
Sensor	<input type="text" value="90"/>	%	
Sensitivity Objects	<input type="checkbox"/>		

Figure 1. Presence detector - Configuration

- **Channel 1-6** [enabled/disabled]: activates or deactivates the different detection channels available. Each channel operates independently, which allows setting parallel criteria (in terms of delays, thresholds and actions) for a fixed amount of hardware sensors. See section 2.1.1.

- **Constant Lighting Control 1-2** [[enabled/disabled](#)]: activates or deactivates the constant lighting control channels. See section 2.1.2.
- **Occupancy Detection** [[enabled/disabled](#)]: activates or deactivates the occupancy detection function. See section 2.1.3.
- **Day/Night** [[enabled/disabled](#)]: activating this functionality makes certain parameters referring to detection sendings and luminosity setpoints become double (see later sections). The objects by which the day ↔ night transitions should be received could be the following:
 - **Control Object: 1-Bit** [[enabled/disabled](#)]: when marked, mode could be switched by writing to a binary object (“**Day/Night**”). It is possible to set which **value** [[0 = Day; 1 = Night / 0 = Night; 1 = Day](#)] should trigger which mode.
 - **Control Object: Scene** [[enabled/disabled](#)]: when marked, mode could be switched by writing to a certain scene value to “**Scene Input**”. Two specific textboxes will show up to enter what scene [[0/1...64](#)] will trigger each mode.

Day/Night	<input checked="" type="checkbox"/>
Control Object: 1-Bit	<input checked="" type="checkbox"/>
Configuration	<input checked="" type="radio"/> 0 = Day; 1 = Night <input type="radio"/> 0 = Night; 1 = Day
Control Object: Scene	<input checked="" type="checkbox"/>
Scene Number (Day) (0 = Disabled)	<input type="text" value="0"/>
Scene Number (Night) (0 = Disabled)	<input type="text" value="0"/>

Figure 2. Day/Night configuration

- **Detection LEDs** [[Disabled / Enabled](#)]: activates or deactivates the LEDs that indicate motion detection. If **Day/Night** has been enabled, the available options will be [[Disabled / Enabled / Enabled Only During the Day](#)]. The LEDs can be also enabled or disabled through the communication object “**Detection LEDs**”.

With regard to LUMINOSITY, the following parameters are available:

- **Internal Sensor.** Parameters to allow compensation of the luminosity values measured by the internal sensors.

- **Correction Factor** $[0...10...80]$ $[x 0.1]$.
- **Offset** $[-200...0...200]$ $[lux]$.
- **Luminosity Correction Objects** $[enabled/disabled]$: when enabled, two 2-byte objects are added and allow to change the values set by parameter: “**Correction Factor – Internal Sensor**” and “**Offset – Internal Sensor**”. Any values out of allowed range ($[0...8]$ and $[-200...200 lux]$ respectively) will be ignored).

Note: *The luminosity correction parameters and objects will only be available for the devices that measure luminosity in lux.*

- **Luminosity Sending** $[enabled/disabled]$: activates or deactivates an automatic sending of the luminosity level in lux or in percentage through the “**Luminosity – Internal Sensor**” object. If enabled, two additional parameters will show:
 - **Period** $[0...15...255 s]$: period to send the luminosity value to the bus, between 0 and 255 seconds. If set to “0”, the periodic sending is disabled.
 - **Luminosity Change to Send** $[0...1...255][x 10 lux] / [0...5...100][\%]$: sets a minimum increment so when two consecutive readings of the luminosity measurement differ in more than such value, an extra sending to the bus will take place. If set to “0”, this option remains disabled.

Luminosity Sending	<input checked="" type="checkbox"/>
Period (0 = Disabled)	15 s
Luminosity Change to Send (0 = Disabled)	1 x 10 lux

Figure 3. Luminosity sending (lux)

With regard to SENSITIVITY, the following parameters are available:

- **Sensor N** $[1...90...100]$ $[\%]$: sensitivity for sensor number *N*.
- **Sensitivity Objects** $[enabled/disabled]$: shows or hides the “**Sensor N Sensitivity**” to allow changeovers of the values set in parameters.

Note: *Once the sensitivity of the sensor has been calibrated, downloading the application program by setting these values by parameter is necessary. The value of the objects will be lost after power failure.*

The project topology shows the following objects as well:

- “**Scene Input**” and “**Scene Output**”: objects to receive or send scene values from or towards the KNX bus.

2.1.1 PRESENCE DETECTION CHANNEL

Presence sensor module allows enabling up to six presence detection channels, as well as setting a different configuration (e.g., the type of the objects to be sent) for each.

2.1.1.1 CONFIGURATION

It is possible to specify **which of the four existing sensors** will be taken into account for each detection channel, together with the following options:

- Motion Detection Conditions.
- Operating Mode.
- Status Lock/Unlock.
- Forced State.
- External Motion Sensor.
- External Switch.
- Type (Light, HVAC, Presence).

These options are detailed next.

Motion Detection Conditions

The channel will switch to the “Detection” state when a motion detection signal is received from the sensors and to the “No Detection” state when such signal is no longer received.

- When the channel switches to the “Detection” state, a time count will begin. This count will be restarted whenever a motion detection signal is received.

- After some time (**detection length**) without further motion detections, the channel will switch to the “No Detection” state.
- At that moment, a new time count (**blind time**) begins so that any motion detections that may take place before it expires will be ignored.
- Once the blind time expires, the device will adopt the “Detection” state as soon as a new motion detection takes place.

Operation Mode

Each of the channels can be configured to work either automatically or semi-automatically:

- **Automatic mode:** allows switching between the Detection and No Detection states not only through actual motion but also through a specific, external object.
- **Semiautomatic Mode:** one of the two states (configurable) will only be reachable through the external switch object.

In any case, writing over the external switch object will make the Detection or No Detection become active immediately.

Status Lock/Unlock

While the channel remains locked, detection sendings to the KNX bus related to that channel will be interrupted, no matter if motion detections are actually taking place or not.

It is possible to lock or unlock a channel through a **binary object** or through a **scene**.

Forced State

Values received through the forced state object will be interpreted by the device as a master detection (or no detection) order. In other words, **this object allows externally overwriting the motion detection signal**. The device response when this object is received is as follows:

- An *On* is received:
 - If the channel was under “Detection”, no actions will take place.

- If the channel was under “No Detection”, it will switch to “Detection”.
- An *Off* is received:
 - If the channel was under “Detection”, it will switch to “No Detection”.
 - If the channel was under “No Detection”, no actions will take place.

After forcing a state, the channel will remain under it for a (configurable) **idle time**. Once this time elapses:

- If the forced state was “No Detection”:
 - The channel will remain under this state, without performing any sendings until further motion is detected.
- If the forced state was “Detection”:
 - If the time elapsed since the last motion detection is greater than the detection length, the channel switches to “No Detection” and sends the corresponding object (unless the channel is found to be disabled).
 - If the time elapsed since the last motion detection has not reached the detection length yet, the channel remains under the “Detection” state without performing any sendings.

The execution of the forced state is unconditional and does not depend on whether the channel remains locked nor on the state of the sensor. In other words, the forced state function **has a higher priority** over other functions.

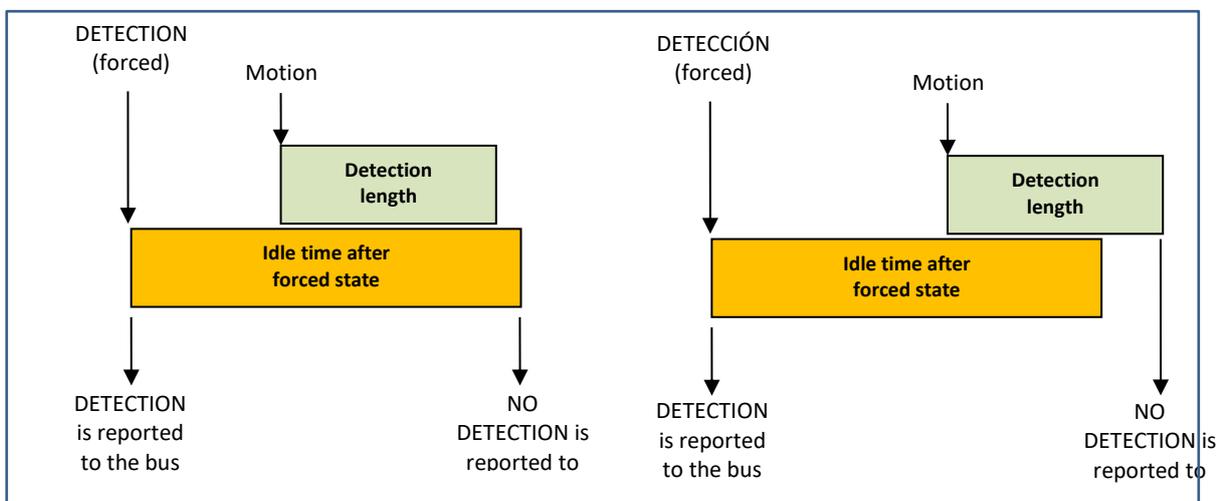


Figure 4. Forced states (example)

External motion detection

An object is available for the **detection of external motion**, so that other KNX devices can inform about motion detection and a joint response can be executed. Whenever this object receives one 1 or one 0, the channel will behave exactly the same as if the actual sensor had detected motion.

Therefore, two types of detectors can be defined:

- **Slave detectors:** it is possible to have several of them. They are in charge of transmitting the detection state to the master detector. To that end, all of them must remain enabled and share the same configuration. The following configuration is recommended:
 - Detection: send one “1”.
 - No detection: no sending.
- **Master detector:** only one master detector must be present. It will be in charge of performing actions over the device under control. The following configuration is recommended:
 - External detection object: enabled and linked to the detection objects from the slave detectors.
 - Detection length: greater than the detection lengths of all the slave detectors.
 - Avoiding forced states is encouraged.

Type

According to the required amount of functionality, each presence detection channel may be configured as a:

- **Presence monitor**

This is the simplest type. It provides the aforementioned functions.

- **Light control**

This is a lighting-dependent channel:

- Detection sendings will only be made if the light level is lower than a certain value (**detection threshold**).

- Detection sendings will not be made if the light level is higher than a certain value (**no-detection threshold**), calculated as:

No-detection threshold = (detection threshold + artificial luminosity contribution) + hysteresis

As the detection threshold, the hysteresis is configurable. However, the artificial luminosity contribution is automatically calculated by presence sensor module.

Under this no-detection status, the luminaries under control remain off even if motion is being detected, since the detection threshold is still exceeded.

Example: suppose a room with the natural light contribution and an artificial luminosity contribution of 200 luxes.

- **Detection Threshold** = 400 luxes.

- **Hysteresis** = 10%

Therefore, the no detection threshold will be:

No Detection Threshold = $(400 + 200) + [(400 + 200) \times 0.1] = 660$ luxes.

- If the current light level is over 400 luxes, the luminaries will remain off even if motion is detected in the room. The additional light contribution is considered unnecessary.
- If the current light level is under 400 luxes, the luminaries are switched on as soon as motion is detected in the room since the light level is insufficient and therefore the artificial contribution becomes necessary.
- Being the luminaries on, once no further motion is detected they will be switched off. No light contribution is necessary as there is no motion.
- Being the luminaries on, if the light level becomes greater than 660 luxes, the luminaries will be switched off making the light level decrease to 460 luxes. No additional light contribution is necessary as such value already exceeds the detection threshold.

Note: For devices where the luminosity is measured in percentage, the behaviour is analogous to the detailed.

● HVAC Control

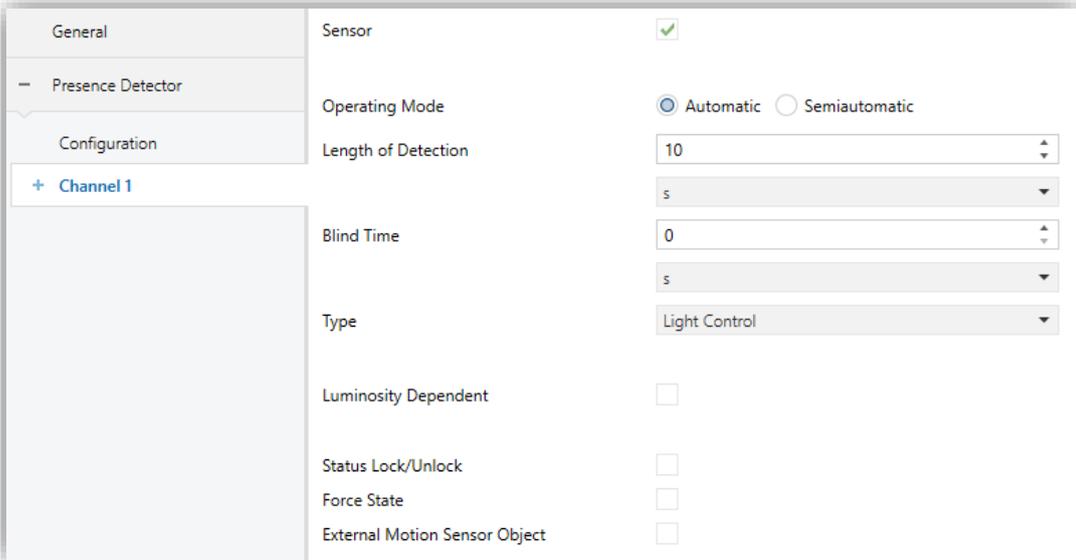
Detection channels destined to control climate systems do not depend on luminosity. They provide a filter to allow switching on the unit only if motion is being detected on a continuing basis, which helps preventing the switch-on of the climate system in case of exceptional or temporary movements.

This filter consists in a set of time windows, which allow switching to the Detection state only if motion has been detected in all of them.

Example: *a two 30-second window filter:*

- *Immediately after the first detection, 30-second count of the first time window will start, considering this window as overcome.*
- *Once the first 30-second time count finishes, a second window begins. If no motion is detected in this time, the process is aborted and does not start over until a new detection takes place. However, if detections do take place during the second window as well, then the Detection state will be adopted immediately.*

ETS PARAMETERISATION



General	Sensor	<input checked="" type="checkbox"/>
Presence Detector	Operating Mode	<input checked="" type="radio"/> Automatic <input type="radio"/> Semiautomatic
Configuration	Length of Detection	10 s
+ Channel 1	Blind Time	0 s
	Type	Light Control
	Luminosity Dependent	<input type="checkbox"/>
	Status Lock/Unlock	<input type="checkbox"/>
	Force State	<input type="checkbox"/>
	External Motion Sensor Object	<input type="checkbox"/>

Figure 5. Presence detection – Channel *i*

The “Configuration” tab contains the following parameters:

- **Sensor n** [*enabled/disabled*]: enables/disables sensor number n for the current channel. If unmarked, detections reported by such sensor will not be taken into account.
- **Operating Mode** [*Automatic/Semiautomatic*]: If the latter is selected, the following parameter will show up:
 - **Action via External Switch Object** [*Detection / No Detection*]: sets which event will only take place through the “[Cx] External Switch” object.
 - “Detection”: the “Detection” state can only be triggered through this object.
 - “No Detection”: the “No Detection” state can only be triggered through this object.

Depending on the above configuration, either both or only one of the two following parameters will be shown.

- **Length of Detection** [*1...10...255*][s] [*1...255*][min] [*1...18*][h]: sets the minimum period of time that must elapse without motion detections before the channel switches to the “No Detection” state (further detections will interrupt this time count). In addition, the “[Cx] Length of Detection” object will be available to allow overwriting this value (in seconds).
- **Blind Time** [*0...255*][s/min] [*0...18*][h]: sets the minimum period of time the channel will remain under the “No Detection” state, even if motion detections are taking place in the room, which will be ignored by the channel.
- **Type** [*Light Control / HVAC Control / Presence Monitoring*]: defines the specific functionality the channel will be oriented to, which will show or hide certain parameters to make the configuration easier:
 - “Presence Monitoring”: shows no additional parameters.
 - “Light Control”: adds the following parameters:
 - **Luminosity Dependent** [*enabled/disabled*]: determines whether the transitions to “Detection” or “No Detection” should depend on the luminosity or not. If enabled, the following parameters will also show up.

- **Detection Threshold** [0...400...2000][lux] / [0...50...100][%]: light level over which motion detections start to be ignored.
- **No Detection Threshold Hysteresis** [10...50] [%]: safety factor for the calculation of the No Detection threshold.
- **Luminosity Measurement Delay** [1...10...255][s/min] [1...24][h]: time period the device will wait for after the detection of motion, prior to calculating the increase in the light level it produces. This time must be greater than the dimming time of the luminaries to ensure that the light level is already stable.

Note: depending on whether the configured **operating mode** is automatic or semiautomatic and, in the latter case, on whether the action for the **external switch object** is Detection or No Detection, some of these three parameters will not be shown.

Type	Light Control
Luminosity Dependent	<input checked="" type="checkbox"/>
Detection Threshold	400 lux
No Detection Threshold Hysteresis	10 %
Luminosity Measurement Delay	10 s

Figure 6. Light control channel

- **“HVAC Control”**: shows the following parameters:
 - **Observation Windows** [1...3...255]: number of time windows in which motion must be detected before switching to Detection.
 - **Observation Time** [1...30...255]: length (in seconds) of each observation window.

Type	HVAC Control
Observation Windows	3
Observation Time	30 s

Figure 7. HVAC Control channel

- **Status Lock/Unlock** [*enabled/disabled*]: sets how the channel can be enabled or disabled:
 - **Control Object: 1-Bit** [*enabled/disabled*]: the channel will switch from active to inactive (and vice versa) by receiving a binary **value** [*0 = Unlock; 1 = Lock / 0 = Lock; 1 = Unlock*] through the “[Cx] Lock Status” object.
 - **Control Object: Scene** [*enabled/disabled*]: the channel will switch between enabled and disabled depending on the scene values received through the “Scene Input” object.

Activating this option implies setting the following parameters as well:

- **Scene to Lock** [*0...64*]: determines the scene number that will lock the channel.
- **Scene to Unlock** [*0...64*]: determines the scene number that will deactivate the channel.

If one of the control objects is enabled, the following parameters are shown:

- **Time to Unlock** [*0...255*]: sets a delay for the re-activation (unlock) of the channel after the reception of the corresponding value.
- **Initial State (After Reset)** [*Last State / Unlocked / Locked*]: determines the state to be acquired by the channel after the start-up of the device or after a bus power failure. After the very first start-up, the last state of the channel is assumed to be “Unlocked”.
- **Send When Locking** [*Nothing / No Detection / Detection*]: sets which value should be sent to the bus once the channel changes to “Locked”, in order to notify that sendings of detection states will be stopped.
- **Send When Unlocking** [*Nothing / No Detection / Detection*]: analogous to the above parameter. It sets the value to be sent to the bus when the channel changes to “Unlocked”, in order to notify that sendings of detection states will be resumed.

Status Lock/Unlock	<input checked="" type="checkbox"/>
Control Object: 1-Bit	<input checked="" type="checkbox"/>
Configuration	<input checked="" type="radio"/> 0 = Unlock; 1 = Lock <input type="radio"/> 0 = Lock; 1 = Unlock
Control Object: Scene	<input checked="" type="checkbox"/>
Scene to Lock (0 = Disabled)	0
Scene to Unlock (0 = Disabled)	0
Time to Unlock	0 s
Initial State (After Reset)	Last State
Send When Locking	Nothing
Send When Unlocking	Nothing

Figure 8. Enabling the channel by using a 1-bit object

- **Force State** [*enabled/disabled*]: enables or disables the “[Cx] Force State” binary communication object.
 - **Idle Time After Forcing State** [*1...10...255*][s] [*1...255*][min] [*1...18*][h]: sets the length of time the channel will remain under the forced state. Please note that forced states ignore the length of detection and the blind time that may have been configured.

Force State	<input checked="" type="checkbox"/>
Idle Time After Forcing State	10
	s

Figure 9. Force state

- **External Motion Sensor Object** [*enabled/disabled*]: allows enabling or disabling a specific communication object (“[Cx] External Motion Detection”) to receive motion detections from other KNX devices, so that several devices can combine their states and perform a joint response.

2.1.1.2 SENDING

Defining custom sendings and custom actions to be performed once the presence detection channel switches from Detection to No Detection (or vice versa) is possible, for both daytime and nighttime:

- **Object type:** Detection and No Detection events can trigger one or several of the following objects, with a customisable value: binary object, scene, HVAC modes and percentage values (scaling).
- **Periodic sending:** objects can be sent to the bus either once or with a configurable period.
- **Delay:** objects will be sent either just after the state switchover or delayed (always within the **Length of Detection**).

ETS PARAMETERISATION

The Sending tab contains the following parameters, which are analogous for both Detection and No Detection.

The screenshot displays the 'Sending' configuration window, divided into two sections: 'DETECTION' and 'NO DETECTION'. Each section contains the following parameters:

- Binary Value:** A checkbox that is checked in both sections.
- Value:** Radio buttons for 'Off' and 'On'. In 'DETECTION', 'On' is selected. In 'NO DETECTION', 'Off' is selected.
- Scene:** An unchecked checkbox.
- Scaling:** An unchecked checkbox.
- HVAC Mode:** A checked checkbox.
- Value:** A dropdown menu. In 'DETECTION', it is set to 'Comfort'. In 'NO DETECTION', it is set to 'Standby'.
- Sending Mode:** Radio buttons for 'Once' and 'Cyclic'. 'Once' is selected in both sections.
- Delay:** A numeric input field set to '0' and a unit dropdown menu set to 's'.

Figure 10. Sending

- **Binary Value** [*enabled/disabled*]: enables or disables the sending of a binary value (as set in **Value** [*Off / On*]) through the “[Cx] Output (Binary)” communication object.
- **Scene** [*enabled/disabled*]: enables or disables the sending of a scene execution order (as set in **Value** [*1...64*]) through the “Scene Output”

communication object.

- **Scaling** [[enabled/disabled](#)]: enables or disables the sending of a percentage value (as set in **Value** [[0...100](#)]) through the “[Cx] Output (Scaling)” communication object.
- **HVAC Mode** [[enabled/disabled](#)] (only if the channel type is “HVAC Control”; see section 2.1.1.1): enables or disables the sending of a special HVAC mode value (as set in **Value**) through the “[PDx] Output (HVAC)” object:

HVAC Mode	Object value
<i>Comfort</i>	1
<i>Standby</i>	2
<i>Economy</i>	3
<i>Building Protection</i>	4

Table 2. HVAC modes

- **Sending Mode** [[Once](#) / [Cyclic](#)]: if the latter is selected, the following field will also be shown:
 - **Period** [[1...5...255](#)][s] [[1...255](#)][min] [[1...18](#)][h].
- **Delay** [[0...255](#)][s/min] [[0...18](#)][h]: sets a delay between the detection state switchover and the actual sending to the bus.

Note: Note that this delay must not exceed the time set in **Length of Detection**, otherwise it may happen that when the delay expires, the status has changed to non-detection and the detection sends will not be completed.

Under a **day and night** dependent configuration (see section 2.1), all parameters regarding the object sending will be duplicated to allow different options depending on whether the detection state switchover takes place during the day or at night.

2.1.2 CONSTANT LIGHTING CONTROL

The aim of the constant light regulation channels is maintaining the room light level as stable as possible around a certain **setpoint** by compensating natural light changes through artificial light.

- As long as **presence is being detected**, periodic light regulation values will be sent. The greater the difference between the setpoint and the actual light

level is, the higher these values will be. In addition, after a detection it will be possible to maintain an **initial dimming level** during some time and/or set a **minimum dimming** that will remain even if the required dimming is lower than that minimum.

Once the light level setpoint is met, light dimming will be interrupted. A **tolerance band** will also be parameterizable to prevent continuous changeovers in the artificial light contribution.

- After switching to **No Detection**, a dimming value of 0% will be sent.

It is possible to define a set of **dimming coefficients**, so the light increments are higher or lower. Please note that too high increment may cause a light contribution greater than needed; to prevent this and the system from regulating over and over, it is encouraged to set the coefficients (P) shown in Table 3, given the luminosity contribution of the elements under control.

Contribution (luxes)	Maximum P	Recommended P
100	255	128
200	128	64
300	85	43
400	64	32
500	51	26
600	43	21
700	36	18
800	32	16
900	28	14
1000	26	13
1100	23	12
1200	21	11
1300	20	10
1400	18	9
1500	17	9
1600	16	8
1700	15	8
1800	14	7
1900	13	7
2000	13	6

Table 3. Maximum and recommended coefficients given the luminosity contribution.

Example:

$P = 15$, setpoint = 450 luxes, current luminosity = 200 luxes.

- Current dimming value = 0%.
- $\text{Increment} = (450 - 200) * (15 / 100) = 37.5$. This value divided by 255 gives 14.70%, which will be the new dimming value to be sent to the bus.
- Assuming this action increases the luminosity up to 280 luxes, the next increment will be $(450 - 280) * (15 / 100) = 25.5$, which equals to 10%. The new dimming value to be sent will be: 14.70% + 10% = 24.70%.

Note: For devices where the luminosity is measured in percentage, the behaviour is analogous to the detailed.

Note: The brightness of notification LEDs may affect the luminosity measurement. For how to disabled them, see section 2.1.

Manual Control

Manual Control allows a direct control over the dimming, disabling automatic dimming. The desired control values must, therefore, be sent via the manual control objects.

Manual control is activated and deactivated by communication object. If it is deactivated, writing a value through any of the manual control objects will also activate this mode.

It is possible to set a duration of the manual control. After exiting the manual control, at the end of its duration or when it is deactivated by object, the states in the background will be recovered and the corresponding regulation sendings will be made.

Manual control takes precedence over 'lock/unlock status' and 'forced control', but if a channel is locked or a status is forced during manual mode, the new status will be restored when exiting the mode.

ETS PARAMETERISATION

The “Constant Lighting Control” tab shows the following parameters:

General	Sensor	<input checked="" type="checkbox"/>
Presence Detector	Operating Mode	<input checked="" type="radio"/> Automatic <input type="radio"/> Semiautomatic
Configuration	Length of Detection	10 s
	Blind Time	0 s
Constant Lighting Control 1	Setpoint	500 lux
	Initial Dimming	<input type="checkbox"/>
	Minimum Dimming	0 %
	Cycle Time	3 s
	Tolerance	25 lux
	P Coefficient for Upward Dimming	26
	P Coefficient for Downward Dimming	26
	Status Lock/Unlock	<input type="checkbox"/>
	Force State	<input type="checkbox"/>
	External Motion Sensor Object	<input type="checkbox"/>
Manual Control	<input type="checkbox"/>	

Figure 11. Constant lighting control

- **Sensor n, Operating Mode, Length of Detection, Blind Time, Status Lock/Unlock, Force State and External Motion Sensor Object:** analogous to those already described for the presence detection channels (see section 2.1.1).

Objects related with these functions are also named accordingly:

- “[CLCx] External Switch”,
 - “[CLCx] Length of Detection”,
 - “[CLCx] Lock Status”,
 - “[CLCx] External Motion Detection”,
 - “[CLCx] Force State”.
- **Setpoint** $[0...500...2000][lux]$ / $[0...50...100][\%]$: target luminosity, which can be modified afterwards through the “[CLCx] Setpoint” object. In case the day / night option has been enabled (see section 2.1), both parameters and objects will be duplicated to allow a different setpoint for each case.
 - **Initial Dimming** $[enabled/disabled]$: sets an initial dimming level to be sent after detection.

- **Value** [0...50...100][%]: level in percentage for the initial regulation.
- **Dwell Time in Initial Value** [1...10...255][s]: time period the channel will maintain the initial dimming level. Once elapsed, the successive dimming values to be sent will be calculated depending on the error between the actual light level and the setpoint.
- **Minimum Dimming** [0...100][%]: minimum value of dimming level when the device is in detection state.
- **Cycle Time** [1...3...255][s]: time period to calculate and send the successive regulation levels during the Detection state.

Note: *it is recommended that this time be greater than the regulation speed of the dimmer associated.*

- **Tolerance** [10...25...255][lux] / [1...2...100][%]: margin or hysteresis to prevent luminosity fluctuations when a stable value is reached.
- **P Coefficient for Upward Dimming** [1...26...255]: value of the proportional coefficient for upward dimming orders. The higher its value, the greater the regulation increment for a fixed error.
- **P Coefficient for Downward Dimming** [1...26...255]: analogous to the previous parameter, for upward dimming orders.
- **Manual Control** [enabled/disabled]: allows a direct control over the dimming. When enabled, the following objects are added:
 - “[CLCx] Manual Control” and “[CLCx] Manual Control (Status)”: 1-bit control and status objects for activating/deactivating and knowing the status of the manual control, respectively.
 - Dimming objects: 1-Byte (“[CLCx] Manual Control: Absolute Dimming (Input)”), 4-Bit (“[CLCx] Manual Control: Relative Dimming (Input)”) or 1-Bit (“[CLCx] Manual Control: On/Off (Input)”). Which also have three status objects associated: “[CLCx] Dimming Value”, “[CLCx] Manual Control: Relative Dimming (Output)” and “[CLCx] Manual Control: On/Off (Status)” respectively.

Moreover, the following parameter appear:

- **Duration (0 = Endless)** [0...255][s] [0...30...255][min] [0...18][h]: time period during the manual control will remain active, unless “0” is received through the object “[CLCx] Manual Control”.

2.1.3 OCCUPANCY DETECTION CHANNEL

For a better understanding of the function of the occupancy detection channels it is important to note that the **detection of motion and presences** does not necessarily imply that the room is currently occupied by people, while in the same way the non-detection does not necessarily imply that the room is not occupied.

The occupancy detection in an algorithm which takes a set of variables (detection events, door opening and closing events) as an input to determine whether **there are individuals or not inside the room** at the moment.

2.1.3.1 CONFIGURATION

The occupancy detection entails combining several devices:

- Motion detectors (one as a **master** and the others as **slaves**),
- **Door opening and closing** sensors or indicators, for entrance and departure monitoring.

The device that incorporates the presence sensor module can either as a master detector or as a slave detector.

Master

The master detector will be responsible for determining whether there is occupancy or not depending on the information it receives from the slave detectors (through the “**Occupancy: Slave Input**”) and on its own information.

Transitions between one occupancy state and the other will trigger object sendings to the KNX bus, according to the configuration set in parameters.

The **occupancy detection algorithm** takes places as follows:

- When a **door opening** is received (through the trigger object): the “**Occupied**” state will be adopted (if not already active).
- When a **door closing** is received (through the **trigger object**):

1. During a certain **waiting time**, the algorithm will ignore any motion detections reported by either the master or the slave detectors.
2. Next, the master starts counting a certain **listening time**.
3. If either the master itself or the slave detectors report motion, the **“Occupied”** state will be adopted (if not already active).
 - a. If the listening time expires after none of the detectors has reported any motion detections, the **“Not Occupied”** state will be adopted.
 - b. From that moment, any motion detection will activate the **“Occupied”** state (if not already active).

Associating certain **sendings** (a binary value, a scene, a percentage value or an HVAC mode) for the transitions between the “Occupied” and “Not Occupied” states and vice versa is possible. A **status object** is also provided which will be sent whenever the occupancy state changes.

Occupancy detection can be enabled or disabled, analogously as in presence detection channels (see section 2.1.1), through the **enablement** and **scene input** communication objects. An extra sending of the aforementioned values (binary, scene, percentage or HVAC) can be performed during the transitions between the Enabled and Disabled, although this will not alter the value of the occupancy **status object**.

While the occupancy detection remains disabled, all the involved events (i.e., motion detections and trigger objects) are ignored.

To prevent undesired occupancy detections (**false occupancy detections**) it is possible to send a scene-recording request object to the bus as soon as, being under the “Occupied” state, the trigger signal is received. If no further detections take place before the listening time elapses, the transition to the “Not Occupied” state will be notified as usually. But in such circumstances, if motion is detected **without having received the trigger value once again**, then the preceding situation will be considered as a “false no-occupation” (actually, the room was still occupied), so an order to **execute the previously recorded scene** will be sent to make the room recover the state it had prior to the transition to the “Not Occupied” state, and the **“Occupied”** state will be adopted again (in this case, the parameterised **sendings** for such transition will not be sent, although the occupancy status object will be).

Example: false empty room detection.

Think of a room with two people sleeping inside (“Occupied” state). If the false occupancy detections are not avoided, when one of them leaves the room the “Not Occupied” state will be adopted. If afterwards the other occupant moves, the state will switch to “Occupied” and the corresponding order will be sent, making for instance the lights turn on. On the contrary, if this option is considered, when the remaining occupant moves the occupancy action will not be executed as no additional trigger values have been received (e.g., a new door opening notification).

Slave

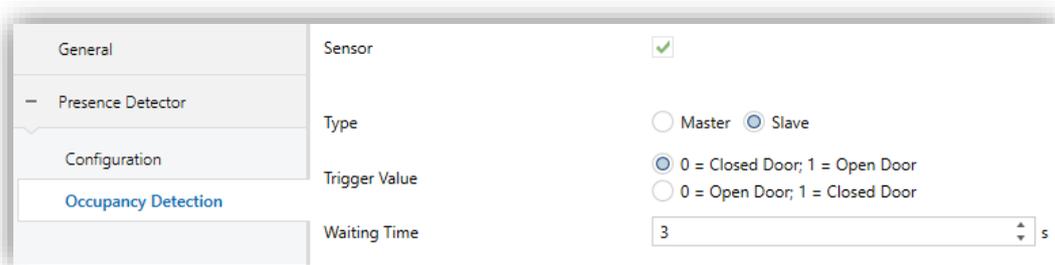
The devices that incorporates the presence sensor module and are configured as slave detector notify the master about detection and no-detection situations (by respectively sending a “1” or a “0” through the **slave output** object), although in this case switching from the detection state to the no-detection state is only possible after the reception of the trigger signal (e.g., a door closing), thus, also the slave detectors provide the **trigger** object.

After the reception of the trigger signal, the slave will allow a certain **waiting time** (configurable), the count of which will be restarted in case the trigger signal is received again. After the time count finishes, the slave switches to No Detection.

Once in No Detection, it will switch to Detection as soon as motion is detected.

ETS PARAMETERISATION

The Occupancy Detection tab shows the following parameters:



General	Sensor	<input checked="" type="checkbox"/>
Presence Detector	Type	<input type="radio"/> Master <input checked="" type="radio"/> Slave
Configuration	Trigger Value	<input checked="" type="radio"/> 0 = Closed Door; 1 = Open Door <input type="radio"/> 0 = Open Door; 1 = Closed Door
Occupancy Detection	Waiting Time	3 s

Figure 12. Occupancy detection (slave)

Common parameters for both master and slave:

- **Sensor n** [[enabled/disabled](#)]: enables/disables sensor number n for the current channel. If unmarked, detections reported by such sensor will not be taken into account.
- **Tipo** [[Master/Slave](#)]: sets the occupancy detection channel type.
- **Trigger Value** [[0 = Closed Door; 1 = Open Door / 0 = Open Door; 1 = Closed Door](#)]: determines which values will indicate the door state, upon reception through “**Occupancy: trigger**”.
- **Waiting Time** [[0...3...65535](#)]: sets the waiting time before switching to No Occupancy, which is counted after the reception of the closed door trigger. This time can be modified through object “**Occupancy: Waiting time**”.

Note: the waiting times in all slave detectors must be greater than (or equal to) the waiting time of the master detector to ensure a proper behaviour.

Exclusive parameters for master detectors:

The screenshot shows a configuration window for a 'Presence Detector'. The left sidebar has tabs for 'General', 'Presence Detector', 'Configuration', and '+ Occupancy Detection'. The main area is titled 'Occupancy Detection' and contains the following settings:

Sensor	<input checked="" type="checkbox"/>
Type	<input checked="" type="radio"/> Master <input type="radio"/> Slave
Trigger Value	<input checked="" type="radio"/> 0 = Closed Door; 1 = Open Door <input type="radio"/> 0 = Open Door; 1 = Closed Door
Waiting Time	2 s
Listening Time	3 s
Occupancy State Object	<input type="checkbox"/>
False Non-Occupied Detection	<input type="checkbox"/>
Status Lock/Unlock	<input type="checkbox"/>

Figure 13. Occupancy detection (master)

- **Listening Time** [[1...3...65535](#)]: sets the value of the listening time, which is counted after the waiting time elapses. This value can be modified afterwards through object “**Occupancy: Listening Time**”.
- **Occupancy State Object** [[enabled/disabled](#)]: enables or disables the “**Occupancy: Occupancy State**” binary object, which allows requesting the current occupancy state anytime.

- **False Non-Occupied Detection** [*enabled/disabled*]: enables or disables the algorithm that prevents false detections of the Not Occupied state, which implies setting the **Scene Number** [*1...64*] to be recorded and executed.
- **Status Lock/Unlock** [*enabled/disabled*]: provides a procedure for temporary locking of sendings of occupancy states. This procedure is analogous to that for the presence detection (see section 2.1.1.1).

2.1.3.2 SENDING

As for presence detection channels, occupancy detection channels allow sending different objects and values to the bus, which can be periodic or delayed (depending on the event type) and different for daytime and night time.

ETS PARAMETERISATION

The Sending tab shows the following parameters:

The screenshot displays the configuration interface for the 'Sending' tab of an occupancy detector. The interface is divided into two main sections: 'OCCUPIED' and 'NOT OCCUPIED'. Each section contains the following parameters:

- Binary Value:** A checkbox that is checked (indicated by a green checkmark).
- Value:** Radio buttons for 'Off' and 'On'. For 'OCCUPIED', 'On' is selected. For 'NOT OCCUPIED', 'Off' is selected.
- Scene:** An unchecked checkbox.
- Scaling:** An unchecked checkbox.
- HVAC Mode:** An unchecked checkbox.
- Sending Mode:** Radio buttons for 'Once' and 'Cyclic'. 'Once' is selected in both sections.
- Delay:** A numeric input field set to '0' and a dropdown menu set to 's' (seconds).

Figure 14. Occupancy detection. Sending

The functionality and configuration are entirely analogous as those already explained in section 2.1.1.2, although in this case the **HVAC Mode** sending type will be always available.

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