Zennio
Passion for KNX innovation

LUMENTO X4 White

4-Channel Constant Voltage PWM Dimmer for white LED DC Loads

ZN1DI-RGBX4

Application program version: [1.2]
User manual edition: [1.2]_a

www.zennio.com

USER MANUAL

Contents

DOCUMENT UPDATES

Version	Changes	Page(s)
[1.2]_a	Changes in application program: • Unconditional transmission of the ON/OFF status object after a switch-on or switch-off order (through any of the objects that permit it), even if it did not imply an actual switch of the previous state and with independence of the parameterised minimum time between transmissions (which is only considered for the Luminosity level status object). • Change in the smooth dimming algorithm on the reception of successive orders: increments are applied to the final luminosity of the previous order, no matter if the dimming process was interrupted.	-
	New introductory section: Temperature of the White Colour.	7, 8
	New example about the Independent Channel Control function.	16
	Example added about the “Multiply” parameter.	24, 25
	Brief clarification about the Start-up function.	31, 32
	General revision of texts and styles.	-
[1.1]_a	Changes in application program : • New general ON/OFF control object with memory. • Improvement of the Custom On/Off controls (new option to change only the luminosity, without affecting the colour). • Improvement of the Scenes function, according to the above approach. • 1-bit object (hold & release) for colour scanning. • Independence between the 3 general controls (1 byte, 4 bits, 1 bit) and their dimming speeds (immediate, smooth 1, smooth 2).	-

1 INTRODUCTION

1.1 LUMENTO X4

LUMENTO X4 is the LED dimming solution from Zennio for single-colour LED DC diode modules or combined LED DC diode modules of up to four colours (Red, Green, Blue and White).

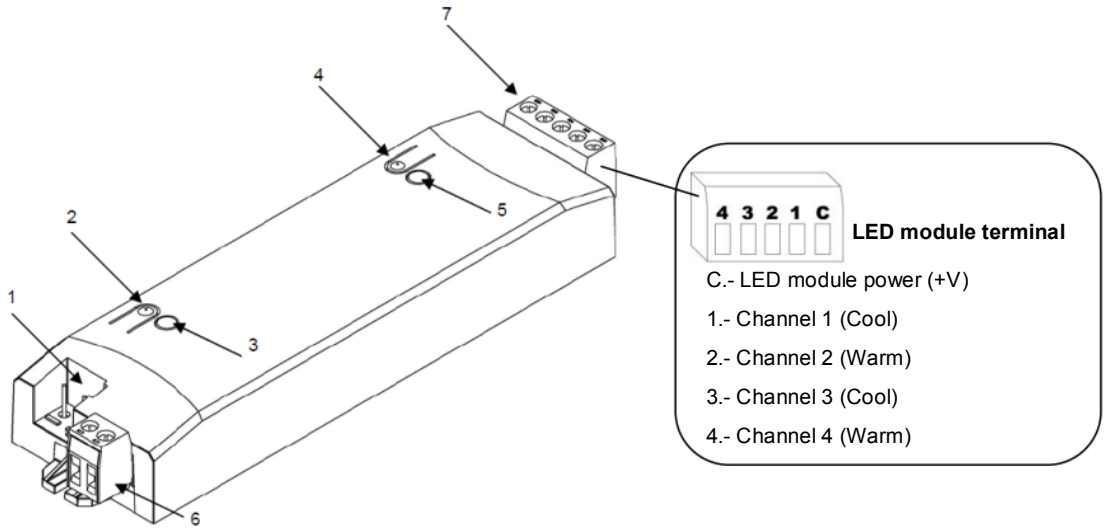
It offers four independent output channels, for modules powered with 12/24 VDC (up to 2.5 A each).

The device may be programmed with three different application programs, depending on the type of the LED modules to be controlled:

- **LUMENTO X4 LED**: independent control over up to four monochrome LED modules, i.e., each channel connected to the output corresponds to an independent single-colour module, which will generally be installed and operated independently of the other modules.
- **LUMENTO X4 RGBW**: joint control over one four-colour (RGBW) LED module, i.e., each channel connected to the output corresponds to one colour component (R, G, B or W) of the same module, being all of them typically controlled jointly.
- **LUMENTO X4 WHITE**: control over Cool/Warm white LED modules (CW), i.e., four white LED strips (two of them Cool and two of them Warm) can be controlled, both jointly and separately for warm LEDs and cool LEDs.

Figure 1. LED Dimmer

1.2 INSTALLATION



1.- KNX Connector 2.- Programming Button 3.- Programming Indicator 4.- Test Button 5.- Test / Reverse Polarity Indicator 6.- External Voltage Terminal 7.- LED Control Terminal

Figure 2. Connection scheme

The device connects to the KNX bus via the incorporated terminal (1), which provides the device with bus power. On the other hand, an additional power supply (12 – 24 VDC, depending on the specific LED module) is needed for dimming the LEDs. The external power supply is connected to the device through the corresponding screw terminal block included in the original packaging (6). The polarity of the external supply must be respected: the positive pole of the external power supply corresponds to the positive pole (+) of the terminal block, and analogously for the negative pole (-). If, for whatever reason, the connection of the power supply is carried out in the inverse way, LUMENTO X4 will report this event through the Test/Reverse Polarity Indicator (5), which will turn orange.

Also provided with the device is a second screw terminal block (7), where every LED module must be connected, as well as the power line (C). The scheme of the terminal block is shown in Figure 2.

- One of the two wires of each LED module is to be connected to one of the slots 1 – 4 in the terminal block, considering that slots 1 and 3 are intended for the **cool white** modules, while slots 2 and 4 are for the **warm white** ones.

- The remaining wire of each LED module should be connected to the remaining slot, which is shared by all four modules and labelled as “C”.

Note: *the output terminal block can be wired before it is inserted into the device.*

Note: *keep in mind that only **LED loads** can be connected to LUMENTO X4.*

Once the device is provided with bus power, both the physical address and the application program can be downloaded, even if no external power is being provided.

After the first connection to the KNX bus or after a download, the programming indicator (3) will typically start blinking in blue while the Test/Reverse polarity indicator (5) remains in constant blue for about 25 seconds. Before performing any action over the device, it is important to wait until both indicators turn off again (i.e., they are not lighting in blue anymore), since LUMENTO X4 is carrying out an internal update.

Note: *if the device is found to be only connected to the KNX bus and the external power is not being supplied, this internal update will be postponed until it is.*

The functionality of the main elements of the device is described below:

- **Programming button**: a short press on this button sets the device into the programming mode, while the associated indicator turns red. If this button is held while plugging the device into the KNX bus, LUMENTO X4 goes into the secure mode. The indicator blinks in red.

- **Test button**: a long press on this button, of at least 3 seconds (until the associated indicator lights in white) activates the Test Mode of the device, which allows verifying the correct connection of the LED modules. This test is carried out as follows: **once the Test Mode is activated, every time the button is short-pressed, the associated indicator colour will change (Red-Green-Blue-White-Red...) while the LED channels turn on successively (1-2-3-4-1...)**, thus making it possible to check whether the LED channels have been properly connected or whether any of them has been interchanged during the connection process. To leave the Test Mode, just press the Test button at least for 3 seconds (until the associated indicator and the LED module switch off).

Note: *while the Test Mode is active, any order received from the KNX bus will be ignored until the deactivation of the mode.*

To obtain detailed information about the technical features of LUMENTO X4 as well as on security and on the installation process, please refer to the Datasheet, included in the original packaging of the device and also available at: http://www.zennio.com.

1.3 TEMPERATURE OF THE WHITE COLOUR

LUMENTO X4 White permits the connection of up to four White LED modules, bringing the option of combining 1-2 modules of the *warm white* type, with 1-2 modules of the *cool white* type.

The concept of the **colour temperature** comes from relating certain colours of the visible spectrum with the temperature at which an ideal black body (an *absolutely cold* body) needs to be heated in order to make the light it radiates acquire that particular colour. Therefore, as it gets heated, the object will first show orange tonalities that will little by little turn approximately bluish as the temperature keeps being increased.

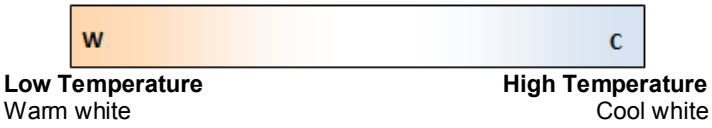


Figure 3. Colour temperature

Nevertheless, although related to lower temperatures, the orange tonalities are known as **warm colours** as they are typically provided by the sunlight, while bluer tonalities are known as **cool colours**, as they typically arise under artificial light and in the absence of the sunlight.

Therefore, it is possible to classify the white colour into **warm white** and **cool white**, depending on the level of the orange or blue tonalities of the white colour.

Through the combination of white LEDs modules of the warm type and those of the cool type, and the appropriate regulation of their respective light levels, LUMENTO X4 White can provide **the entire range of the intermediate white tonalities**, in case such function is enabled. It is also possible, however, to discard the colour temperature function, so that LUMENTO X4 simply implements a joint control of the light level in all the white modules connected to the output, as if all of them were of the same type.

In the particular case of enabling the colour temperature function and of connecting a pair of modules of each type, LUMENTO X4 will offer a set of communication objects and parameters for a unified control of the two LED modules that form the warm channel, as well as those for the unified control of the two LED modules that make up the cool channel, so in practice it can be operated as if there were only two output channels: C and W.

2 CONFIGURATION

The LUMENTO X4 White application program allows, as stated in the previous section, controlling the **luminosity** of up to four LED DC white diode modules, both jointly and independently. Moreover, if *warm white* modules are combined with *cool white* LED modules, it will be possible to regulate the temperature of the resulting colour, by setting different luminosity levels to the output channels.

The above means that while other application programs available for LUMENTO X4 permit the regulation of the resulting colour, LUMENTO X4 White focuses on the resulting **colour temperature**, while the colour itself will always be white. This is possible by controlling the four output modules in pairs: LED strips 1 and 3 form the Cool White channel (C) while LED strips 2 and 4 form the Warm White channel (W).

Last, it will be possible to configure a set of additional functionalities, which makes LUMENTO X4 a very versatile device:

- Wide range of alternatives for controlling the **general luminosity**, as well as the joint **colour temperature** and the **luminosity of each channel**.
  - 1-bit objects for a general and per-channel **switch-on / switch-off**.
  - 4-bit objects for general and per-channel **step dimming**.
  - 1-byte objects for general and per-channel **precise dimming** (in percentage).
  - 1-byte scene-friendly object, with a number of **pre-set colours**.
  - 1-bit object, “hold & release” oriented, that lets the user trigger a **colour temperature scan**, and afterwards stop it once the desired temperature is reached.
- **General dimming features**, such as:
  - **Smooth-dimming** times for progressive colour transitions.
  - Different dimming modes (At once, Smooth 1 or Smooth 2) for each case.
  - Restriction of the **maximum allowed light** level.

- Possibility of performing **independent regulations** on each channel (C, W).
- **Custom ON/OFF**: possibility of enabling up to four different ON/OFF controls, with a specific colour temperature, luminosity and dimming type for each case.
- **Simple Timer and Flashing**: timed ON/OFF sequences of the LED modules.
- **Scenes/Sequences**: possibility of enabling up to ten different scenes/sequences, which can consist in a single **luminosity** change, a **colour temperature** change or a **custom sequence** (5 customisable steps).
- **Block**: option to lock/unlock the control over the LED modules.
- **Start-up**: permits selecting a custom start-up state (after a bus failure or an ETS download/reset) for the LED modules connected to the device, as well as sending the status objects to the KNX bus (immediately or after a delay).
- **Error identification**: detection of anomalous situations affecting the correct behaviour of the device: external voltage errors and overheating errors.

3 ETS PARAMETRISATION

To begin with the parameterisation process of LUMENTO X4 it is necessary, once the ETS program has been opened, to import the database of the product (**LUMENTO X4 White** program).

Next, the device should be added to the project where desired. And then, one right-click on the device will permit selecting "Edit parameters", in order to start the configuration.

3.1 DEFAULT CONFIGURATION

This section shows the default device configuration the parameter edition starts from.

Figure 4. LUMENTO X4 White Default topology

The following communication objects appear:

- **Dimming**: a 4-bit object destined to step-dimming the general brightness (luminosity) level. Steps (upwards or downwards) of 1%, 2%, 3%, 6%, 12%, 25%, 50% and 100% are possible.

- **Precise Dimming**: a 1-byte object destined to perform a precise dimming over the general brightness level, by setting a concrete percentage value.

- **On/Off**: a 1-bit object destined to perform a general switch-on or switch-off of the LED strips. A switch-on order through this object will recover in any case the colour temperature that was active prior to the switch-off, with either the maximum luminosity (100%) or with the luminosity level it had before the switch-off (depending on the **On Light Level** parameter; see section 3.2).

- **Dimming Speed 1**: a 1-byte object that allows modifying, in runtime, the speed of the “Smooth 1” dimming (see section 3.2).

- **Dimming Speed 2**: similar to Dimming Speed 1, but referred to the “Smooth 2” dimming.

When entering the parameter edition of LUMENTO X4 White for the first time, the following window will be shown:

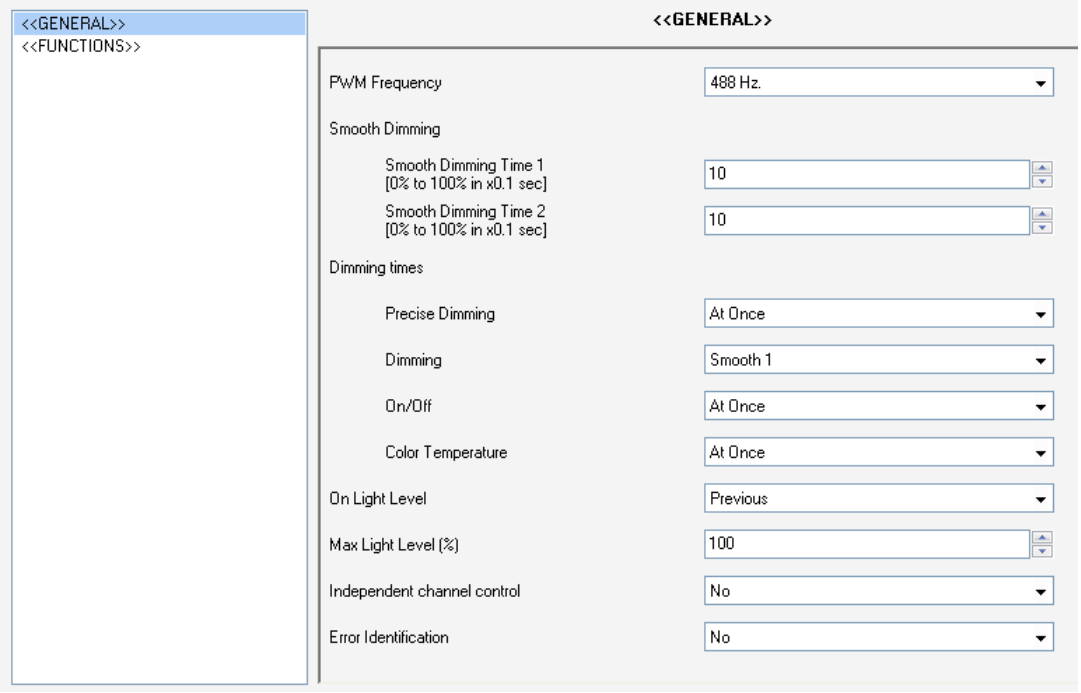


Figure 5. Parameterisation screen by default

As shown in Figure 4, the parameterisation window is divided into two main tabs, which will be explained in detail in the next sections:

- **General**: permits parameterising global features of the device.
- **Functions**: permits enabling and configuring specific functions of the device.

3.2 GENERAL WINDOW

This section of the parameter edition allows setting several global features of LUMENTO X4 White:

- **PWM Frequency**: the working frequency of the LED regulator. The available values are: 150, 300, 488 and 600 Hz. The default frequency is 488 Hz.

- **Smooth Dimming**: the time LUMENTO X4 takes to perform soft luminosity transitions. Two different smooth transition modes are available (Smooth 1 and Smooth 2). The times here refer to the complete transition, from 0% to 100%, and the permitted values are from 3 to 65535 tenths of a second. Both parameters are 10 (i.e., 1 second), by default.

  The Smooth Dimming Times 1 and 2 can be decreased (although not increased) in runtime, via the "**Dimming Speed 1**" and "**Dimming Speed 2**" communication objects, respectively. Please refer to Table 1 for the relationship between the most common speed values and their associated dimming times.

Dimming Speed	Dimming Times (T = parameterised time)
0%	*T*
25%	¾*T*
33%	⅔*T*
50%	½*T*
75%	¼*T*
100%	0*

Table 1. Dimming speeds and times

(*) The minimum dimming time is actually 3 tenths of a second.

Example:

*Let the parameterised time for the Smooth Dimming Time 1 be equal to 20 seconds. At a given time during the execution, the smooth dimming is required to be performed in half the time, so this time becomes 10 seconds. To achieve this, the value 50% should be sent to the "**Dimming Speed 1**" object. If the original time were to be reduced to the fourth part (from 20 to 5 seconds) it should be "75%" the value to be sent to the mentioned object. Sending the value "0%" through "**Dimming Speed 1**" will recover the original smooth dimming time 1 (20 seconds)*

Smooth dimming from/to values other than 0% - 100% (on-off) is also performed at the same speed, so the time required to carry it out will always be proportional to (and lower than) that parameterised under "Smooth Dimming Time".

Example:

Let the parameterised value for the "Smooth dimming time 1" be 10 seconds ("100"). A global switch-on order is then sent when the output is off, so it will take 10 seconds to reach the maximum brightness level (if the "Dimming" parameter has been configured as "Smooth 1"). However, if the LEDs were already at a brightness percentage of 50%, the time required to reach the full brightness (100%) will be 5 seconds (one half of the 10 seconds parameterised).

Four more parameters are shown next, grouped as "**Dimming Times**":

- **Precise Dimming**: this field can be used to define whether transitions commanded through both the general and the channel-dependent "Precise Dimming" objects (in other words, dimming orders performed by sending a certain luminosity value, in percentage) should be Immediate, Smooth 1 (a progressive transition, according to the defined Smooth Time 1) or Smooth 2 (a progressive transition, according to Smooth Time 2).

- **Dimming**: defines whether step-by-step transitions (i.e., through the 4-bit **Dimming** objects, both the global object and those referring to each channel independently) should be Smooth 1 (a progressive transition will be performed, according to the defined Smooth Time 1) or Smooth 2 (progressive transition according to the defined Smooth Time 2).

- **On/Off**: permits defining the transition type (At Once, Smooth 1 or Smooth 2) that will apply to the switch-on or switch-off orders.

- **Colour Temperature**: sets the transition type (At Once, Smooth 1 or Smooth 2) that will apply to colour temperature changes.

Note: *smooth dimming is intended to let the user appreciate a progressive change in the luminosity level, with the option to interrupt it once the desired level is reached. Therefore, this function is typically linked to a pushbutton that, once released by the user, stops the smooth dimming that began when it was pressed. Because of this, it is advisable to parameterise a dimming step of 100%, so a sole long press (instead of successive long presses) is enough to step through all the available light levels and to stop at the most comfortable one*.

Finally, apart from the desired dimming times, the following parameters are shown:

- **On Light Level**: sets the desired level of luminosity for the switch-on orders received through the global On/Off object. In other words, it permits setting whether the LEDs will acquire the maximum brightness level ("100%") or the one they had prior to the switch-off ("Previous") whenever a switch-on order arrives. On the very first switch-on, the luminosity will be set at 100% (and the colour will be white).

  Note: *on a global switch-on, the LEDs recover the colour they had prior to the switch-off, although the luminosity itself will turn maximum or not depending on the option selected for this parameter. Apart from the exception of the first switch-on (which will imply white colour and full luminosity), in the particular case of performing the switch-on after having set, accidentally or not, all three channels to zero through their respective dimming (or precise dimming) objects, the colour acquired on the switch-on will as well be white (and the luminosity, maximum). The example below illustrates this.*

Example:

The following sequence illustrates a set of actions and their effects. Assume that the "On Light Level" has been parameterised as "Previous".

#	Action	Effect
1	*Download.*	*-*
2	*Global switch-on order.*	***50% Temp.** and 100% brightness*
3	*[C] Precise dimming = 5%.*	*Cool white level = 5%*
4	*[W] Precise dimming = 5%.*	*Warm white level = 5%*
5	*[C] Precise dimming = 0%.*	*Cool white level = 0%*
6	*[W] Precise dimming = 0%.*	*Warm white level = 0%*
7	*Global switch-off order.*	*-*
8	*Global switch-off order.*	***White** (100% brightness) (**)*

(*) If a complete switch-off had not occurred as a consequence of individually setting all three channels to zero, the global switch-on would have recovered (because of the parameterisation) the previous colour temperature and, moreover, the same luminosity level.

- **Max Light Level (%)**: defines the maximum effective brightness, in percentage (from 5% to 100%), that can be applied to the channels through a dimming order. If this parameter is set to a value other than 100%, a proportional reduction of the luminosity will apply. However, for coordination

and update purposes, LUMENTO X4 will always send to the KNX bus the theoretical luminosity value, between 0% and 100%.

Example:

Let the value of this parameter be "70%". In such case, dimming orders for a luminosity of 100% will actually set the luminosity to 70% (although the status object will in fact show the value "100%"). Analogously, orders for a luminosity of 50% will actually set it to 35% (although the status object will show "50%").

- **Independent Channel Control (CW)**: enabling this option brings up six communication objects that make it possible to switch on/off each channel independently ("**[X] On/Off**"), as well as to control their luminosity levels separately ("**[X] Dimming**" and "**[X] Precise dimming**"). If after sending a control order to an individual channel (precise dimming, step dimming, dimming stop order, etc.) an additional global dimming order (precise or by steps) is also sent, the last colour temperature will remain constant during a global regulation (the brightness of both channels will change, but not the proportion between them).

Example:

*Assume that the initial colour temperature is 100% (thus, a pure cool white –the warm channel is completely off–; see "Colour temperature" in section 3.3.2). A precise dimming order is then sent to the warm channel ("**[W] Precise Dimming**" = 100%) and another one to the cool channel ("**[C] Precise Dimming**" = 0%), which indirectly sets a colour temperature of 0% (pure warm white). If a global regulation takes place now (for example "**Precise Dimming**" = 25%), the colour temperature will not change at all: the cool channel will still be off, although the LEDs of the warm channel will now light with a lower intensity (at 25%).*

- **Error Identification**: this option displays two 1-bit communication objects to report anomalous behaviours that may arise when LUMENTO X4 is working:

  - **"Error: Overheating".** Object through which LUMENTO X4 notifies it is exposed to an excessive temperature (**higher than 90ºC**), by sending the value "1". In that moment, LUMENTO X4 will reduce the brightness level of

the channels to 50% (only if their current level is higher) and the working frequency will be set to its minimum value (150 Hz). When the temperature is again lower than 80ºC, LUMENTO X4 will send the value "0" through this object, thus showing the end of this event and it will recover the brightness and frequency values it had before the error. If 15 minutes after the beginning of the Overheating error the temperature is still not lower, LUMENTO X4 will directly switch off its output, for safety reasons.

Note: *take into account that, even if the error identification has not been enabled by parameter, the overheating protection is* ***always enabled****, although in that case the bus will not be notified*.

- **"Error: External voltage".** Object through which LUMENTO X4 notifies that the received external power is incorrect, due to any of these events: too low voltage, total absence of power (source disconnected) or inversion in the polarity of the power supply (this is also visually notified by the Test indicator, which turns on in orange). When LUMENTO X4 detects any of these anomalous situations, it sends the value "1" through this object. When the event finishes, it sends a "0".

3.3 FUNCTIONS

LUMENTO X4 White offers a set of different functions (see Figure 5), which may be selectively enabled, depending on the requirements of the KNX system.

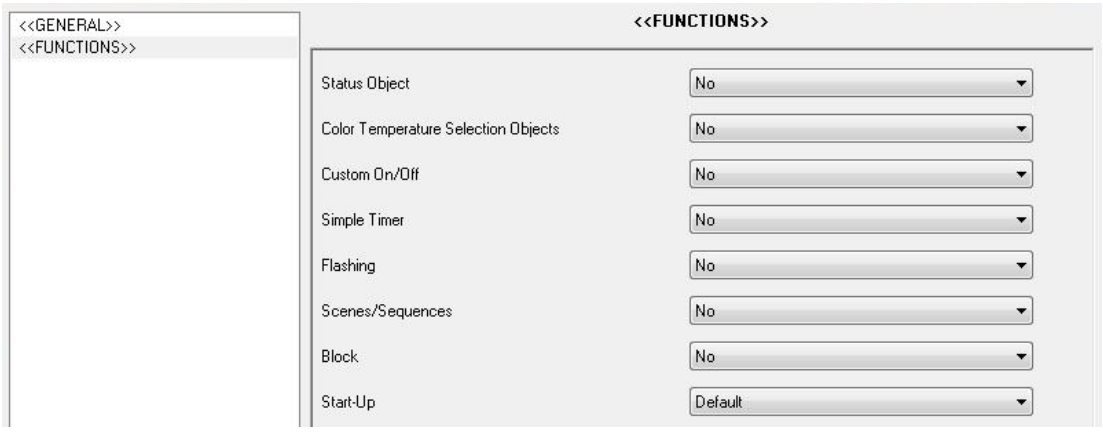
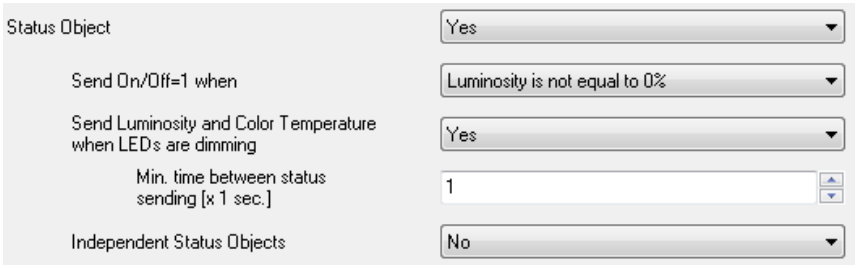


Figure 6. Functions

The available functions are detailed next.

3.3.1 STATUS OBJECTS

This function allows enabling a 1-bit status object ("**On/Off Status**") and a 1-byte status object ("**Luminosity (Status)**"), responsible for reporting the general state of the output at any time, thus updating other devices in the KNX system, if required. It also enables the "**Color Temperature (Status)**" 1-byte object, which informs about the current colour temperature of the emitted white light.



- **Send On/Off=1 when**: sets when the value "1" (on) is sent through the "On/Off (Status)" object to the bus, being the following options possible:

  - Luminosity is not equal to 0%: when the brightness level gets to a value different from 0%, the object "On/Off (status)" will be send the value "1". The value "0" will be only sent when the luminosity reaches 0%.

  - Luminosity is equal to 100%: the "On/Off (Status)" object will only send the value "1" when the brightness level gets equal to 100%. The value "0" will be only sent when the luminosity reaches 0%.

  The ON/OFF status object is sent in any case after the reception of an ON/OFF order through the analogous control object.

- **Send Luminosity and Color Temperature when the LEDs are dimming**: this option allows selecting whether to send the brightness and colour temperature states of the output (through the "Luminosity (Status)" and "Color Temperature (Status)" objects) or not (default option). If enabled, the following field will be also shown:

  - **Minimum time between status sending**: sets the minimum time (in seconds) between consecutive brightness and colour temperature values sent to the bus through the "Luminosity (Status)" and "Color Temperature (Status)" objects. This restriction applies to smooth dimming.

- **Independent status objects**: activates four additional communication objects (two for the "C" channel and two for the "W" channel) which report the state of each channel, independently and at any time. These objects are "**[X] On/Off (Status)**" and "**[X] Luminosity (Status)**", which behave analogously to the general status objects.

3.3.2 COLOUR TEMPERATURE SELECTION OBJECTS

Enabling this function brings up three new communication objects: "**Direct Color Temperature**" (1 byte), "**Color Temperature**" (1 byte) and "**Color Temperature shift**" (1 bit).

- **Direct Color Temperature**: it is a 1-byte communication object that permits directly selecting one of the 9 pre-set white colour temperatures. It works similarly to "Scene" objects. Every predefined colour temperature is associated to a certain number (from 1 to 22), as shown in Table 2. If one of these values (decremented by 1) is written to the "**Direct Color Temperature**" object, the output will change to the corresponding colour temperature **immediately** (regardless of the dimming types –At once, Smooth 1 or Smooth 2– parameterised under the General screen).

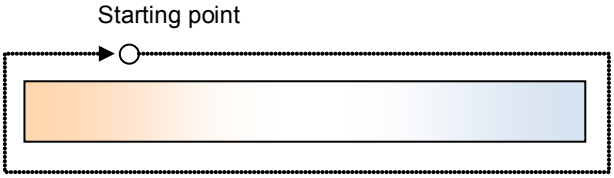
Scene (Value)	White Type	Colour Temp.	%C	%W
1 (0)	OFF	-	0	0
2 (1)	Cool White	100%	255	0
3 (2)	Cool White (Light)	100%	128	0
4 (3)	Natural White	66%	171	84
5 (4)	Natural White (Light)	66%	86	42
6 (5)	Day White	33%	84	171
7 (6)	Day White (Light)	33%	42	86
8 (7)	Warm White	0%	0	255
9 (8)	Warm White (Light)	0%	0	128

Table 2. Predefined white spectrum.

- **Color Temperature**: it is a 1-byte communication object that permits setting, in percentage, the desired value of the colour temperature, i.e., the ratio between the luminosity of the C channel and that of the W channel. The allowed values are 0 - 100%, being 100% a purely cool white colour and 0% a purely warm white colour.

- **Color Temperature Shift**: this is a 1-bit object that lets the user start an automatic scan over the entire temperature spectrum, being possible to stop it as soon as the desired temperature is found. This object is supposed to be combined with a **"hold and release" push button**, so that pressing it (the value "1" is sent) starts the scan, and releasing it (the value "0" is sent), stops it.

  The scan takes place from the current colour temperature towards the coolest, then towards the warmest, and then again back to the coolest (and so on). The complete cycle takes 15 seconds and it does not affect the current luminosity level at all, so no temperature scan will take place if it is triggered while all the channels are set to 0%



Note: *the temperature scan will be interrupted not only on the reception of the value "0" through the "Color Temperature Shift" object, but also on the arrival of any valid order through the following objects: "Scenes/Sequences" (1 byte), "Block" (1 bit), "Start/stop sequence" (1 bit) and "Direct Color Temperature" (1 byte) or "Color Temperature" (1 byte).*

3.3.3 CUSTOM ON/OFF

Once enabled, this function offers up to 4 additional ON/OFF controls, independently customisable:

Figure 7. Custom ON/OFF

The following parameters can be set for each of the custom ON/OFF controls:

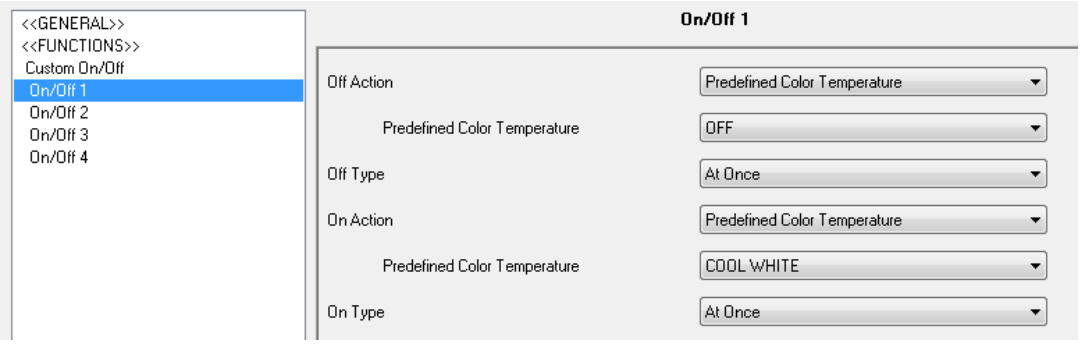


Figure 8. Custom ON/OFF configuration

- **Off Action**: sets the action to be run over the LED modules when LUMENTO X4 receives the value "0" through the "**Custom ON/OFF**" 1-bit object. This can consist in a change in the luminosity ("Luminosity", which will display a new parameter to set the desired value) or a temperature colour change, being possible to select a specific temperature from the predefined range ("Predefined Color Temperature", which displays a drop-down list with all the possible values; see Table 2) or a manually-defined temperature ("CW Color Temperature", which will permit inserting numeric values –from 0 to 255– for C and W).

- **Off Type**: sets the desired dimming type for the switch-off of the LED modules: At once, Smooth 1 and Smooth 2.

- **On Action**: sets the action that will be executed on the LED module when LUMENTO X4 receives the value "1" through the "**Custom On/Off X**" 1-bit object. Analogously to the "Off action" mentioned above, a luminosity or colour temperature change are possible, as well as state-recovery switch on ("Last Color Temperature"), so that whenever LUMENTO X4 receives a "0" through the corresponding "Custom On/Off" object, it saves into memory the value of the current colour temperature. After that, when the ON order arrives ("Custom On/Off" = 1), LUMENTO X4 will turn the LEDs on and will recover the last colour temperature.

Example:

Suppose that Custom On/Off control number 2 is parameterised with "Off Action" = Day White and "On Action" = Last Color Temperature, and that at a certain time the active temperature is Cool White. A switch-off order (value "0") then arrives through the

"Custom On/Off 2" object, so the light will change to Day White (Off Action), prior to which LUMENTO X4 stores in memory the colour temperature that was active before the switch-off. When a new switch-on order (value "1") is received, the LEDs will be switched on again and LUMENTO X4 will recover the colour temperature stored before the switch-off (Cool White).

- **On Type**: sets the desired dimming type for the switch-on of the LED strip: At once, Smooth 1 or Smooth 2 (see section 3.2 for the parameterisation of the dimming times).

3.3.4 SIMPLE TIMER

This function allows performing a switch-on of the LED modules connected to LUMENTO X4 and a later, automatic (timed) switch-off, being also possible to insert delays. The time length, the temperature and the switch-on type can also be parameterised.

This function may be useful when a switch-on (of a certain duration, i.e., the LEDs will be automatically switched off afterwards) is required, for example, upon movement detection.

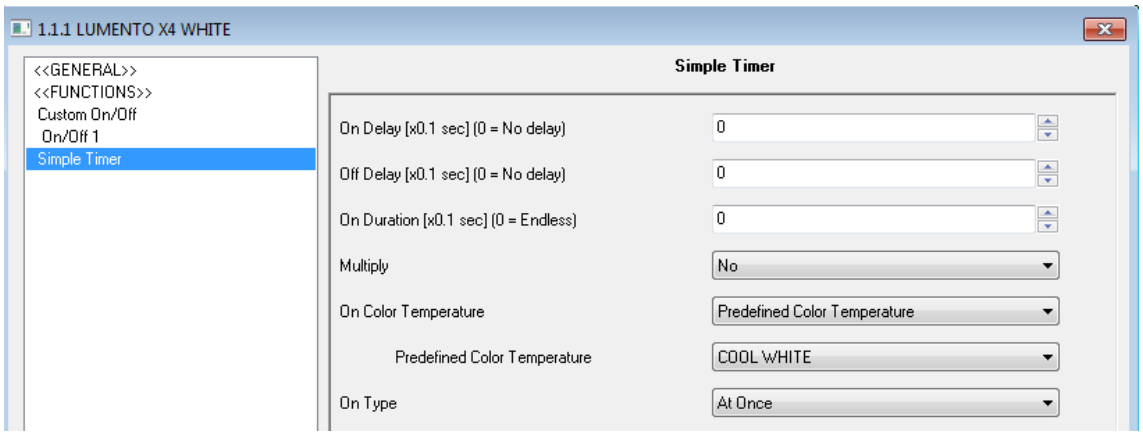


Figure 9. Simple timer

- **On Delay**: this parameter sets the time LUMENTO X4 will wait since the reception of the Timer ON order (**Simple Timer** = 1) and the actual switch-on of the LED modules. This value must be set in tenths of a second (e.g. for a delay of 2.5 seconds, typing "25" is required). If no delay is needed, this field must remain zero.

- **Off Delay**: this parameter sets the time to be waited between the reception of the Timer OFF order (**Simple Timer** = 0) and the actual switch-off of the LED modules. Works similarly to the On Delay.

- **On Duration**: this parameter sets the time the LED modules will stay on before switching off again. A 0 in this field means endless, i.e., no timing is applied to the switch-on.

In other words, the behaviour of the simple timer is as follows:

  - When LUMENTO X4 receives a "1" through the "**Simple Timer**" communication object, an ON order is sent to the output, applying the On Delay (if parameterised). The output stays on, depending on the On Duration, and then turns off (unless this duration has been parameterised with “0”).

  - When LUMENTO X4 receives a "0" through the "**Simple Timer**" communication object, the output is switched off with the corresponding Off Delay (if parameterised).

- **Multiply**: allows progressively increasing (multiplying), in runtime, the On Duration time or the On/Off delays. Two situations are distinguished:

  - **No multiply**:

    - If the On delay count is already running, it will be reset every time a new “1” is received through the “**Simple Timer**” object.

    - If the output has already been activated and the On Duration time is counting, it will be reset whenever a new “1” is received.

    - If the Off delay count is already running, it will be reset every time a new “0” is received.

  - **Multiply**:

    - If the On delay count is already running and the value “1” is received several times through the “**Simple Timer**” object, then the actual delay time will be “n” times the parameterised time, being “n” the number of times the value “1” is received.

- If the output has already been activated and while the On Duration time is counting the value "1" is received several times, then the actual duration will be "n" times the parameterised time, being "n" the number of times the value "1" is received.

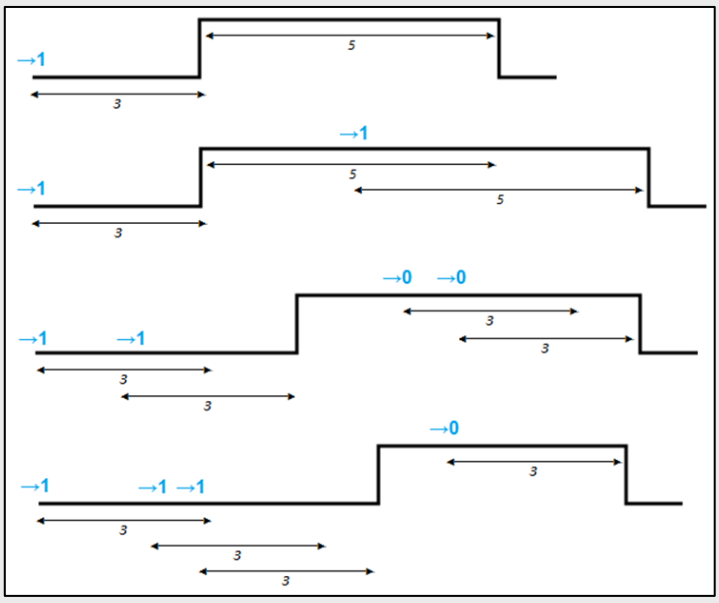
- If the Off delay count is already running and the value "0" is received several times, then the actual delay time will be "n" times the parameterised time, being "n" the number of times the "0" is received.

Note: *the multiply option may result particularly useful under parameterisations with no ON and OFF delays. Nevertheless, as already explained and as the following example shows, these delay times, if parameterised with a value other than 0, do also admit multiplication*.

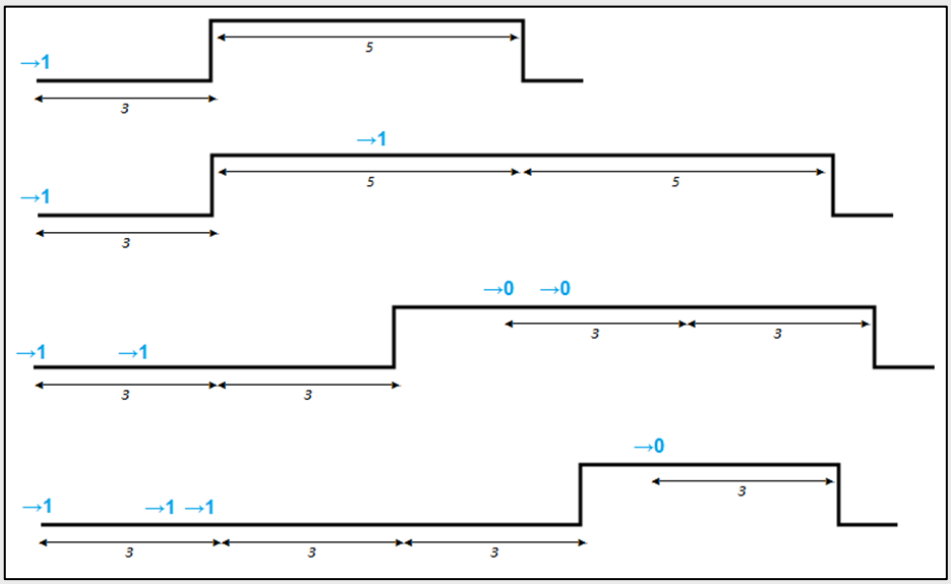
Example:

Let the following be parameterised: On Delay = 3 seconds; Off Delay = 3 seconds, On Duration = 5 seconds. The graphs bellow reflect some possible situations if the values "0" or "1" are received from the (which is represented as →0 and →1), respectively for the cases of having the "multiply" option enabled and disabled.

With no multiplication:



With multiplication:



- **On Color Temperature**: sets the desired colour temperature for the ON state. Either a predefined temperature (see Table 2) or a customized value (by manually configuring each of the C/W intensities) can be selected.

- **On Type**: sets the dimming type to be applied during the timed switch-on of the LED modules, being the possible options: At once, Smooth 1 and Smooth 2. See section 3.2 for the parameterisation of the dimming types.

3.3.5 FLASHING

This function allows executing **ON-OFF-ON-OFF** sequences in the LED modules, where it is possible to parameterise the length of the ON/OFF stages applied to the LED modules. Moreover, the number of repeats can be set by parameter, as well as the colour temperature for the “on” state and the final colour temperature of the LEDs after the last repetition.

The intermittence will start when LUMENTO X4 receives a "1" through the "**Flashing**" object and stops after executing all the configured repetitions (endless repetition is possible by setting the value “0” in the corresponding box, as shown later). It is possible to stop the flashing at any time, by sending the value "0" through the "**Flashing**" object, or by sending any other control order that affects the output (like an on/off, a sequence, etc.). If, during the flashing execution, LUMENTO X4 receives a

new order to start the flashing sequence ("Flashing" = 1), it will be reset no matter what the current stage of the sequence is.

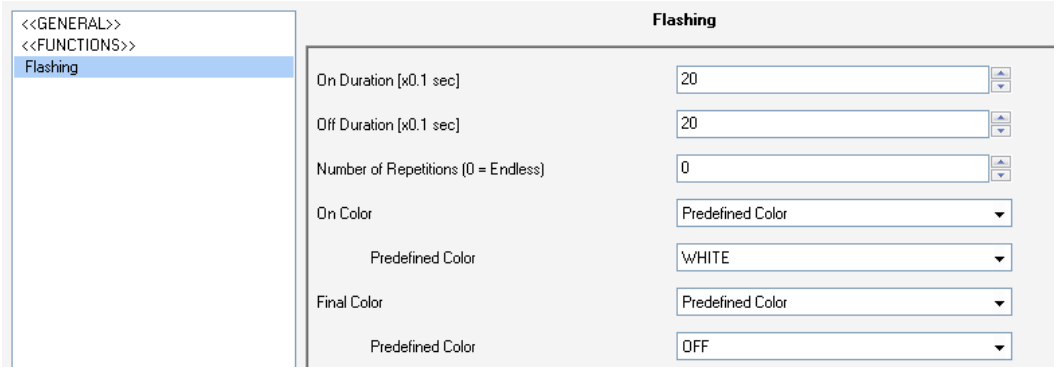


Figure 10. Flashing

These are the parameters that can be configured for the flashing function:

- **On Duration**: sets the length of "ON" stages of the flashing sequence, i.e. the time the channels will remain on before turning off again.
- **Off Duration**: sets the length of "OFF" stages of the flashing sequence, i.e. the time the channels will remain off before turning on again.
- **Number of Repetitions**: defines the number of times the ON/OFF sequence will be repeated when the flashing function is triggered. For an unlimited number of repeats, the value "0" should be typed here (the sequence will be repeated until the reception of an order to deactivate the flashing).
- **On Color Temperature**: sets the colour temperature to be adopted by the output during the "on" stages. Either a predefined value (see Table 2) or a customized temperature (by manually defining the CW components) can be selected.
- **Final Color Temperature**: sets the colour temperature to be adopted by the output once the last flashing sequence ends, as well as when the "**Flashing**" = 0 order is received. Either a predefined value (see Table 2) or a customized temperature (by manually defining the CW components) can be selected.

3.3.6 SCENES/SEQUENCES

This function allows defining different scenes, which consist in a specific light ambient

or a dimming sequence, so they can be triggered when the corresponding value is received from the bus through the "**Scenes/Sequences**" 1-byte object.

The "**Start/Stop Sequence**" 1-bit object will be displayed to allow re-executing the last sequence played (by writing the value "1") or stopping the current sequence in execution ("0").

Note: *the "Start/Stop Sequence" object only applies to dimming sequences, and has no effect over static scenes. Moreover, after a download from ETS (partial or complete), if the value "1" is sent through this object, the triggered sequence will be the first one that was parameterised, unless it is of the "Fixed Color Temperature" type; in such case the first one different from this type will be executed.*

LUMENTO X4 White allows configuring up to **ten scenes/sequences**, which can be individually enabled from "Scenes/Sequences" in ETS.

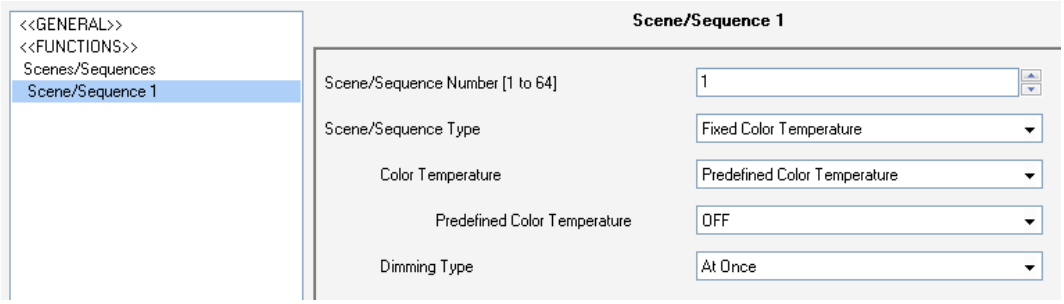


Figure 11. Scenes / Sequences

For each of them, the following configurable fields are available:

- **Scene/Sequence Number**: indicates the scene/sequence identifying number (from 1 to 64) whose reception (decreased by 1, according to the KNX standard) through the "**Scenes/Sequences**" object will make the device apply the configuration to the LED modules.

- **Scene/Sequence Type**: selects the desired action for each enabled scene/sequence:

  - **Fixed Color Temperature.** The scene will consist in setting the output to a specific colour temperature when the "Scenes/Sequences" object is received with the configured scene number. Either a predefined temperature (see Table 2) or a custom value (by manually setting the CW components) can be selected. If "Fixed Color Temperature" is selected,

besides running scenes it will be also possible to **save** them: if the device receives a scene save order (values 128-191 through the mentioned object), the current luminosity levels of the LED modules will be saved, so when the same scene is executed again, the colour temperature acquired will be the one that was saved (and not the originally parameterised in ETS).

Finally, if "Fixed Color Temperature" is selected, the "**Dimming type**" parameter will also be shown, making it possible to choose an Immediate, Smooth 1 or Smooth 2 dimming for this action.

- **Luminosity.** The scene execution will in this case consist in changing the general luminosity level, without changing the colour temperature. This option displays two new parameters: **Luminosity** (which sets the desired level, from 0 to 255) and **Dimming Type** (which sets the desired transition type: At once, Smooth 1 or Smooth 2).

- **Custom Sequence.** Selecting this option will make it possible to customise sequences of up to 5 steps/actions, by setting the following parameters:

  - **Cyclic**: "Yes" will define a cyclic sequence (after the last parameterised step, the sequence will start over), while "No" will define a non-cyclic sequence (in such case, there is also the possibility of triggering –after the last step of the sequence– another parameterised sequence).

  - **Luminosity and Color Temperature Sending**: this parameter can be set to Send continuously (during the light dimming, the brightness level and the colour temperature will be sent to the KNX bus through the "**Luminosity (Status)**" (as well as the analogous per-channel objects, if enabled) and "**Color Temperature (Status)**" objects, only if the option to send statuses has been activated from the General screen; note that the parameterised minimum time for the status sending will apply here) or to Send when sequence ends (the brightness levels and the colour temperature will be sent to the bus once the last step of the sequence finishes, no matter if the option to send the status objects during the dimming is enabled or not from the General screen). However, in both

cases, the status objects need to be enabled by parameter (see section 3.3.1).

For every step, the following parameters can be configured:

- **Color Temperature**: sets the desired colour temperature (either in terms of the CW luminosities, or a predefined value).
- **Dimming Type**: At once, Smooth 1, Smooth 2 or Equal to action time. If the latter is selected, the dimming will be carried out gradually, taking as much time to switch from the current to the next one as defined in the "Time" field.
- **Time**: sets the time length of the step (i.e., the time LUMENTO X4 will wait before running the next step), in seconds.

The steps (or actions) will be executed in order. Thus, when LUMENTO X4 receives the Scene number that triggers the sequence, the first configured step will be executed. Moreover, if the sequence is cyclical, once the last step finishes, the sequence will be automatically executed again from the beginning.

An example of custom sequence configuration is shown in Figure 11, where the first three steps of Sequence 1 have been parameterised.

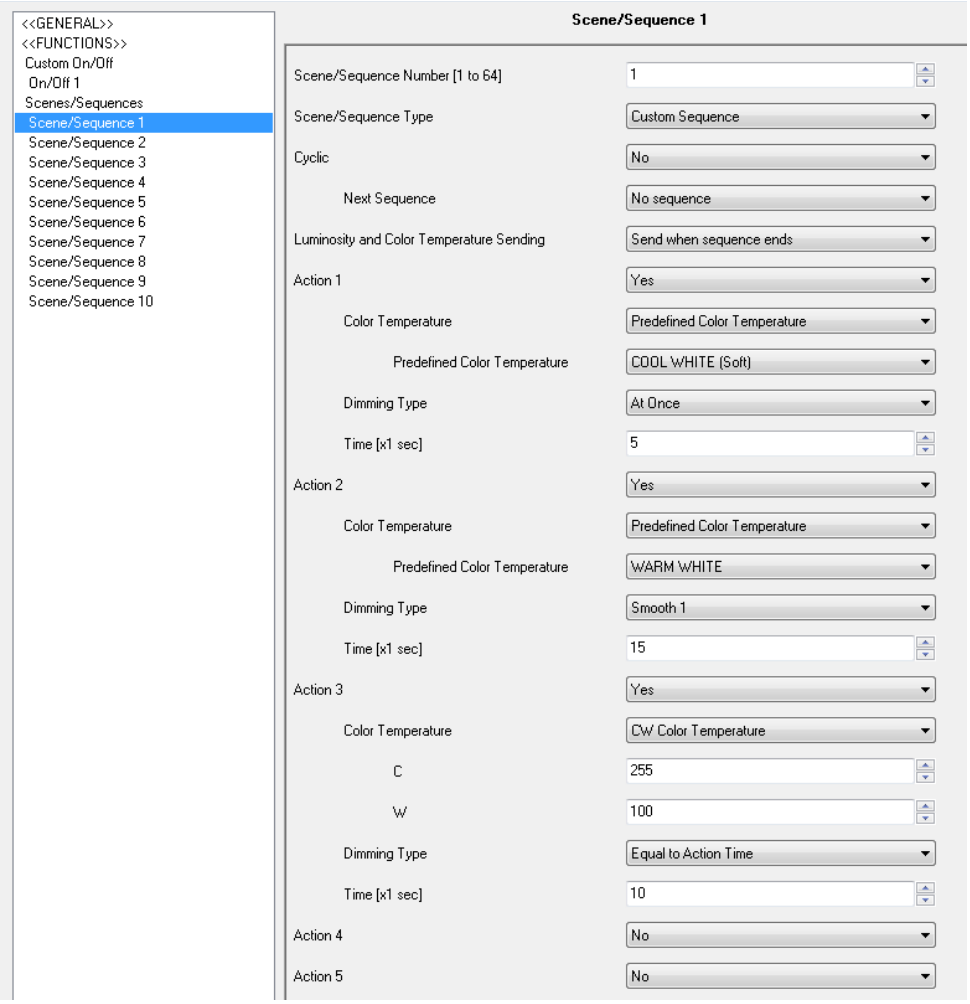


Figure 12. Custom sequence

3.3.7 BLOCK

This function permits locking the output of the device; i.e., disabling the control of the LED modules.

LUMENTO X4 will lock the output when it receives a "1" through the "**Block**" 1-bit communication object, which is displayed after enabling this function. From that moment, any action being executed will be stopped and the LED modules will maintain the colour and luminosity they had when the lock order arrived.

While locked, any order received from the KNX bus will be ignored by the device, i.e., the output will perform no actions.

LUMENTO X4 will unlock the output when the value "0" arrives through the "**Block**" object. The LEDs will still maintain the colour they had before receiving the lock order.

No luminosity change commands received during the lock state will be taken into account by the output, not even after the unlock event.

3.3.8 START-UP

This function permits setting the desired state to be applied to the modules when the device starts up. A default or a custom configuration may be selected.

If the default configuration is chosen, the LEDs will stay off after a download from ETS. On the other hand, after a bus voltage recovery the luminosity will be the same as before the bus power failure.

Under a custom configuration, it is possible to customise the state of the LED modules after a bus voltage recovery and after a download from ETS.

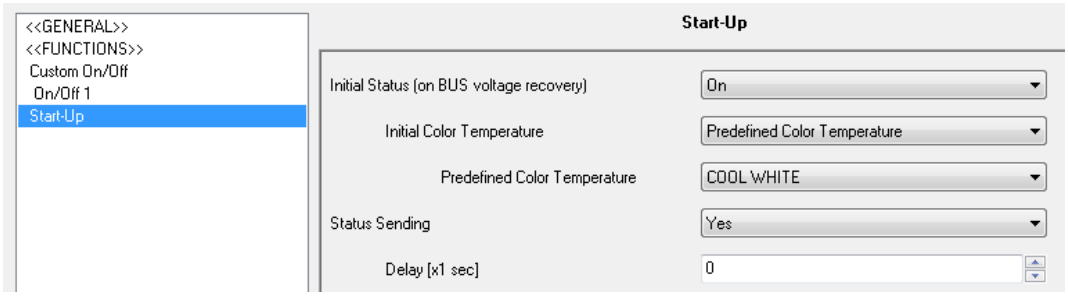


Figure 13. Start-up

The following parameters can be configured:

- **Initial Status (on bus voltage recovery)**: sets the initial status the LED modules will adopt when the bus power failure situation ends or after a download from ETS.

  - Last: the LED modules will recover the same colour temperature and brightness levels they had before the bus power failure. Note that this option does not apply after a download (the LEDs will stay off).

  - Off: the LEDs will always be initially off.

  - On: the LEDs will always be initially on, under the colour temperature defined through the "**Initial Color Temperature**" parameter, which can be a CW value or a predefined temperature (see Table 2).

- **Status Sending**: by enabling this parameter ("Yes"), the state of the LED modules will be sent to the KNX bus on a power recovery or after a download, thus updating other devices in the KNX system that may need it. When enabled, a new parameter is shown: "**Delay**". This field sets the time (in seconds) that LUMENTO X4 waits until it transmits the status objects. To get an immediate transmission (no delay), this field should remain zero. The start-up state transmission is performed through the "**On/Off (Status)**" and "**Luminosity (Status)**" objects (and through the analogous channel-dependent status objects) as well as through the "**Color Temperature (Status)**" object. Note that the status objects need to stay enabled (see section 3.3.1).

Note: *bus power failures do not turn the LED modules off, unless the external power supply is also affected by the failure.*

ANNEX I. COMMUNICATION OBJECTS

- **Functional range**" shows the values that, with independence of any other values permitted by the bus according to the object size, may be of any use or have a particular meaning because of the specifications or restrictions from both the KNX standard or the application program itself.

- "**1st boot**" shows the cases where an object is assigned a certain value by the application program after a device download or a full reset. In case the value of such assignment can be parameterised, √ is shown in column "**P**". Objects showing a hyphen (-) are not assigned a particular value and therefore can be assumed to be initialised with the value "0" or with the corresponding updated value in case they depend on an external element (sensors, etc.). Moreover, if the object is sent (or is there an option to send it) to the bus (write or read requests) after a download or a device reset from ETS, the marks **(W)** or **(R)** will be shown, respectively for transmissions or read requests.

- "**Reboot**" shows the cases where an object is assigned a certain value by the application program after a bus power failure. In case the value of such assignment can be parameterised, √ is shown in column "**P**". Objects showing a hyphen (-) are not assigned a particular value and therefore can be assumed to maintain their previous value after the failure or with the corresponding updated value in case they depend on external elements (sensors, etc.). Moreover, if the object is sent (or is there an option to send it) to the bus (write or read requests) after a bus failure, the marks **(W)** or **(R)** will be shown, respectively for transmissions or read requests.

Number	Size	I/O	Flags	Data Type (DPT)	Implemented range	1st boot	P	Reboot	P	Name	Function
0 - 1	1 Bit	I	C - - W -	DPT_Switch	0/1	-		-		[X] On/Off	0=Off; 1=On
2 - 3	4 Bit	I	C - - W -	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) 0x2 (Dec. by 50%) 0x3 (Dec. by 25%) 0x4 (Dec. by 12%) 0x5 (Dec. by 6%) 0x6 (Dec. by 3%) 0x7 (Dec. by 1%) 0x8 (Stop) 0x9 (Inc. by 100%) 0xA (Inc. by 50%) 0xB (Inc. by 25%) 0xC (Inc. by 12%) 0xD (Inc. by 6%) 0xE (Inc. by 3%) 0xF (Inc. by 1%)	-		-		[X] Dimming	4 bits dimmer ctrl
4 - 5	1 Byte	I	C - - W -	DPT_Scaling	0% - 100%	-		-		[X] Precise Dimming	1 byte dimmer ctrl

Number	Size	I/O	Flags	Data Type (DPT)	Implemented range	1st boot	P	Reboot	P	Name	Function
6	4 Bit	I	C - - W -	DPT_Control_Dimming	0x0 (Stop) 0x1 (Dec. by 100%) 0x2 (Dec. by 50%) 0x3 (Dec. by 25%) 0x4 (Dec. by 12%) 0x5 (Dec. by 6%) 0x6 (Dec. by 3%) 0x7 (Dec. by 1%) 0x8 (Stop) 0x9 (Inc. by 100%) 0xA (Inc. by 50%) 0xB (Inc. by 25%) 0xC (Inc. by 12%) 0xD (Inc. by 6%) 0xE (Inc. by 3%) 0xF (Inc. by 1%)	-		-		Dimming	4 bits dimmer ctrl
7	1 Byte	I	C - - W -	DPT_Scaling	0% - 100%	-		-		Precise Dimming	1 byte dimmer ctrl
8	1 Bit	I	C - - W -	DPT_Switch	0/1	-		-		On/Off	0=Off; 1=On
9 - 10	1 Bit	O	C T R - -	DPT_Switch	0/1	- W	√	- W	√	[X] On/Off (Status)	0=Off; 1=On
11 - 12	1 Byte	O	C T R - -	DPT_Scaling	0% - 100%	- W	√	- W	√	[X] Luminosity (Status)	0 - 100 %
13	1 Bit	O	C T R - -	DPT_Switch	0/1	- W	√	- W	√	On/Off (Status)	0=Off; 1=On
14	1 Byte	O	C T R - -	DPT_Scaling	0% - 100%	- W	√	- W	√	Luminosity (Status)	0 - 100 %
15 - 18	1 Bit	I	C - - W -	DPT_Switch	0/1	-		-		Custom On/Off	0=Off; 1=On
19	1 Bit	I	C - - W -	DPT_Switch	0/1	-		-		Simple Timer	0=Deactivate; 1=Activate
20	1 Bit	I	C - - W -	DPT_Start	0/1	-		-		Flashing	0=Deactivate; 1=Activate
21	1 Byte	I	C - - W -	DPT_SceneControl	0-63 (run) 128-191 (save)	-		-		Scenes/Sequences	Scene/Sequence value
22	1 Bit	I	C - - W -	DPT_Enable	0/1	0		-		Block	0=Unblock;1=Block
23	1 Bit	I	C - - W -	DPT_Start	0/1	-		-		Start/Stop Sequence	0=Stop; 1=Start
24	1 Byte	I/O	C - R W -	DPT_Scaling	0% - 100%	-		-		Dimming Speed 1	0%=Min. Speed; 100%=Max. Speed
25	1 Byte	I/O	C - R W -	DPT_Scaling	0% - 100%	-		-		Dimming Speed 2	0%=Min. Speed; 100%=Max. Speed
26	1 Byte	I/O	C - R W -	DPT_SceneControl	0 - 8	-		-		Direct Color Temperature	Color number (Scene 1-9)
27	1 Bit	O	C T R - -	DPT_Alarm	0/1	0		-		Error: External Voltage	0=Normal; 1=Low Ext. Voltage
28	1 Bit	O	C T R - -	DPT_Alarm	0/1	0		-		Error: Overheating	0=Normal; 1=Overheating
29	1 Byte	I	C - - W -	DPT_Scaling	0% (W) - 100% (C)	-		-		Color Temperature	0 - 100 %
30	1 Byte	O	C T R - -	DPT_Scaling	0% (W) - 100% (C)	- W	√	- W	√	Color Temperature (Status)	0 - 100 %
31	1 Bit	I	C - - W -	DPT_Start	0/1	-		-		Color Temperature Shift	0=Stop; 1=Start

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