PRODUCT MANUAL

LUMENTO X3 RGB

RGB LED Controller

ZN1DI-RGBX3

Program version: 1.2

Manual edition: 1.2_a

INDEX

DOCUMENT UPDATES

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1.2_a	Changes since version 1.1 of the application program: • New ON/OFF general control object (with memory) • Improvement of the Custom On/Off controls (new option to only change luminosity, without affecting the color). • Improvement of Scenes, according to the above approach. • 1-bit object (hold & release) for color scanning. • Independency between the 3 general controls (1 byte, 4 bits, 1 bit) and their dimming speed (immediate, smooth 1, smooth 2). • New 3-byte control: "RGB Color"	-
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1. INTRODUCTION

1.1. LUMENTO X3

LUMENTO X3 is a **Zennio** controller that allows operating LED diode modules, both three-color (Red, Green and Blue; RGB-type LEDs. See section 1.3) and monochrome modules.

It includes 3 independent output channels, powered with 12-24 VDC and up to 2.5 A each.

This controller allows being programmed with two different application programs, depending on the type of the LED modules to be controlled:

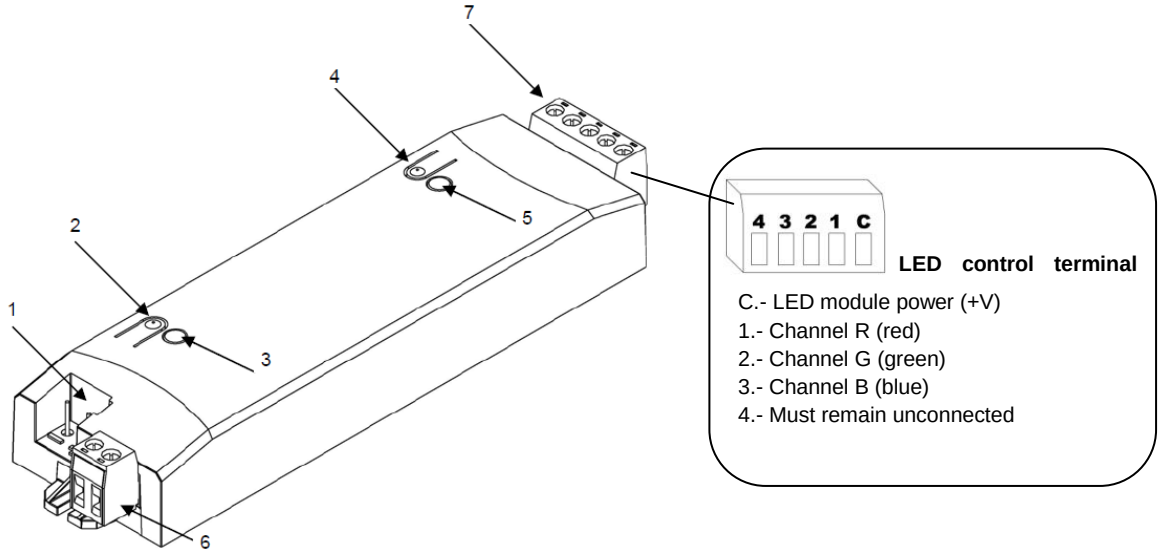
- **LUMENTO X3 RGB:** joint control over one tricolor (RGB) LED module, i.e., each channel connected to the output corresponds to one color component (R, G or B) of the same module, requiring this module to be controlled jointly.

- **LUMENTO X3 LED:** independent control over up to 3 monochrome LED modules, i.e., each channel connected to the output corresponds to an independent monochrome module, which will generally be installed and operated independently of the other modules.

Figure 1.1. Lumento X3 LED controller

1.2. INSTALLATION

Figure 1.2 shows the connection scheme of LUMENTO X3:



1.- KNX connector 2.- Programming button 3.- Programming indicator 4.- Test button 5.- Test / Reverse polarity indicator 6.- External power supply terminal block 7.- LED control terminal block

Figure 1.2. Lumento X3. Connection scheme

The LUMENTO X3 controller connects to the KNX bus via the connecting terminal (1) included with the device, which provides bus power. On the other hand, an additional power supply is needed for LED dimming (the LEDs need to be fed with external 12 / 24 VDC power, depending on the specific LED module). The external power supply is connected to the controller (in order to properly regulate the voltage applied to the LEDs) through the corresponding terminal block with screws included in the original packaging (6). Every cable must be properly connected: from the positive of the external power supply to the positive (+) of the terminal block and from the negative of the power supply to the negative (-) of the terminal block. If, for whatever reason, the connection of the power supply is carried out in the inverse way, LUMENTO X3 will report this event through the Test/Reverse polarity indicator (5), which will turn orange.

Also provided with the controller is a second terminal block with screws (7), where every channel of the LED module must be connected, as well as the power line (+V). A scheme of the terminal block appears in figure 1.2, with detail of each connection point.

Note: *These cables can be screwed to the terminal block before inserting it on the device*.

Note: *It is important to keep always in mind that* ***only LED loads*** *can be connected to LUMENTO X3 RGB.*

Once the controller is provided with power from the KNX bus, both the physical address and the associated application program can be downloaded.

After the first connection to the KNX bus during the installation process or after the download of a new version of the application program on LUMENTO X3, the programming indicator (3) will typically start blinking in blue as well as the Test/Reverse polarity indicator (5) remains in constant blue, for about 25 seconds. Before performing any action over the controller, it is important to wait until both indicators turn OFF again (they are not lighting in blue anymore), since LUMENTO X3 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 controller is described below:

- **Programming button:** a short press on this button sets the controller into the programming mode, while the associated indicator turns red. If this button is held while plugging the device into the KNX bus, LUMENTO X3 goes into 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 checking the correct connection of the LED module. This test is carried out as follows: **once the Test Mode is activated, every time the button is short-pressed, the associated indicator color will change, as well as the color of the LED module**, depending on the enabled channel in every press. While the color sequence in the LED module is "Red-Green-Blue-OFF-Red...", the sequence in the indicator will be "Red-Green-Blue-White-Red...". If the LED module is properly connected to the controller (through the corresponding terminal block), the color that will light with every press (red, green or blue) will be the same as in the Test indicator, meaning that no channel was interchanged during the connection process. To leave the Test Mode, just push 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 more detailed information about the technical features of LUMENTO X3, as well as security and installation information, please refer to the controller **Datasheet**, included in the original package of the device and also available at: http://www.zennio.com.

1.3. RGB LED DIODES

The LUMENTO X3 RGB application is able to dim the **color** and the **luminosity** of the RGB LED modules. Although, in reality, both color and luminosity consist in adjusting the level of the light emitted by the component colors of each diode (i.e., a change in the luminosity is actually an adjust in those levels), luminosity changes are performed maintaining the proportion between the components – in practice, it does not seem to be the color what *changes*, but the level of luminosity.

Therefore, RGB LED diodes are able to emit light in three different colors: Red, Green and Blue. The result of mixing these three colors in the same proportion is the White color, as it can be seen in Figure 1.3. The other intermediate colors are obtained by mixing the main colors in different proportions.

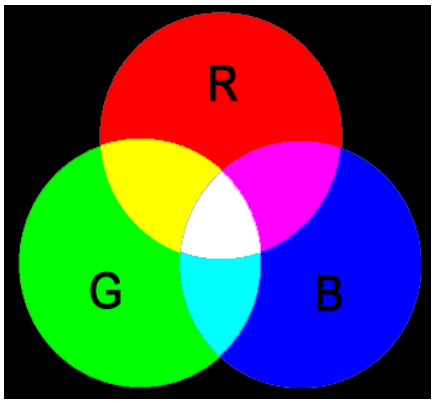


Figure 1.3. Red, Green and Blue mixture

As explained above, luminosity (or brightness) refers to the amount of light that the LED strip is emitting at a given time. The value of the overall brightness of the set of diodes has been defined as the brightness of the channel that emits with the highest intensity. The overall brightness regulation is carried out so that, visually, the chosen color is maintained at any time, by increasing or decreasing the brightness component of the three channels, without losing their proportions.

Note: *The color that one visually perceives (the actually generated color) may vary from the theoretical color, depending on the LED module and the color diffuser used.*

2. CONFIGURATION

The LUMENTO X3 RGB application allows, as stated in the previous section, controlling both the color and luminosity of an RGB LED module. Moreover, it will be possible to configure a set of additional functionalities, which make the controller a very versatile device:

- Wide range of alternatives for the LED strip color control, both **general** control and **channel** (R, G, B) control.
  - 1-bit objects for 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).
  - 3-byte object for multi-channel **precise dimming** (in percentage).
  - 1-byte "scene-friendly" object, with a **number of preset colors**.
  - 1-bit object for **color scanning & detention** upon recognition of the desired color.
- **General dimmer features**, such as:
  - Smooth-dimming times for progressive color transitions.
  - Dimming type (At once, Smooth 1 or Smooth 2) desired for each situation.
  - Maximum light level.
- **Custom ON/OFF:** possibility of enabling up to 4 different ON/OFF controls, setting a certain color or luminosity value for each case, as well as the dimming type.
- **Start-Up**: customization of the initial status of the LED module when the KNX bus power is recovered and sending (immediately or with a delay) of the status to the KNX bus.
- **Simple timer and Flashing**: timed ON/OFF events of the LED module.

- **Scenes/Sequences**: possibility of enabling up to 10 different scenes/sequences, which can consist in **a color change,** a **luminosity change,** a **predefined sequence** or a **custom sequence** (5 customizable steps).

- **Block:** option to lock/unlock the control over the LED module.

- **Error identification:** LUMENTO X3 RGB is able to detect anomalous situations that may affect the correct behaviour of the device: external voltage errors and overheating errors.

3. ETS PARAMETERIZATION

To begin with the parameterization process of the LUMENTO X3 RGB controller it is necessary, once the ETS program has been opened, to import the data base of the product (**LUMENTO X3 RGB** application 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.

In the following sections a detailed explanation can be found about each of the different functionalities of LUMENTO X3 RGB in ETS.

3.1. DEFAULT CONFIGURATION

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

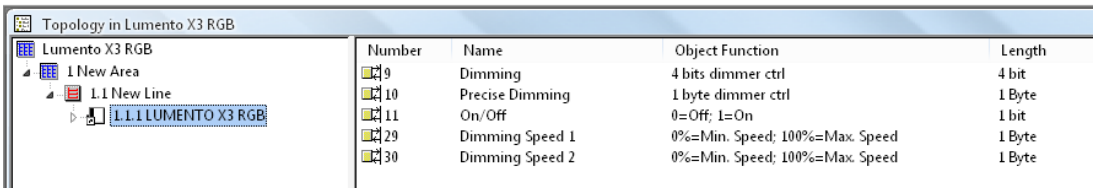


Figure 3.1. LUMENTO X3 RGB Default topology

The following communication objects appear:

- **Dimming:** a 4-bit object destined to perform general luminosity dimming (increasing/decreasing), step by step. Steps of 1%, 2%, 3%, 6%, 12%, 25%, 50% and 100% are permitted.

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

- **On/Off:** a 1-bit object destined to perform a general switch-on or switch-off of the LED strip. A switch-on order through this object recovers in any case the color 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 General Screen).

- **Dimming Speed 1:** a 1-byte object that allows modifying, in execution time, the speed of the “Smooth 1” dimming. (See section 3.2. General Window. Smooth Dimming Time).

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

- **RGB Color:** 3-byte object that permits performing, according to the KNX standard, precise dimming of the luminosity values of the three output channels jointly, being each of the three bytes of the object associated to the desired color on the corresponding channel.

When entering the parameter edition of LUMENTO X3 RGB for the first time, the following window will be shown:

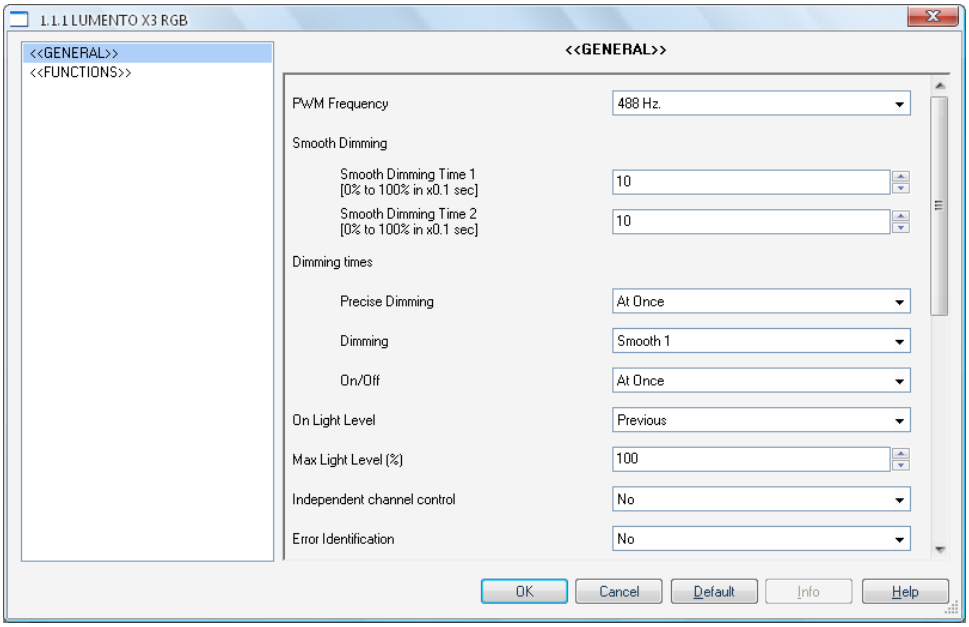


Figure 3.2. Parameterization screen by default

As seen in figure 3.2, the parameterization window is divided into two main screens, which will be explained in detail in the next sections:

- **General:** permits parameterizing global features of the controller.

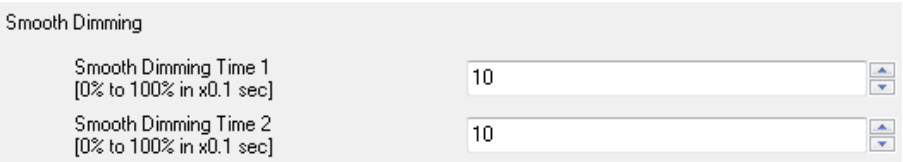
- **Functions:** permits enabling and configuring specific functionalities of the controller.

3.2. GENERAL WINDOW

This section of the parameter edition allows setting several global features of LUMENTO X3 RGB:

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

- **Smooth Dimming**: the time LUMENTO X3 takes to perform soft luminosity transitions. There are two possible smooth transitions (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 values are initially 10 (1 second), by default.



Smooth Dimming Times 1 and 2 can be decreased (although not increased) in execution time, via the communication objects "Dimming Speed 1" and "Dimming Speed 2", respectively. Please check Table 3.1 for the relation between several dimming speed values (the most common) and their associated dimming times.

Dimming Speed object (1 or 2)	Dimming Time (T = parameterized time)
0%	T
25%	¾ T
33%	⅔ T
50%	½ T
75%	¼ T
100%	0*

* Dimming is done in the minimum time allowed for this dimming type: 3 tenths of a second.

Table 3.1. Dimming speeds and times

Consider the following application example.

✓ *Example:*

Suppose a Smooth Dimming Time 1 with a parameterized value of 20 seconds. At a given time during the execution, the smooth dimming is required to be performed in half the time (regardless of the brightness percentage to reach), so this time must become 10 seconds. To achieve this, the value 50% must be written 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).

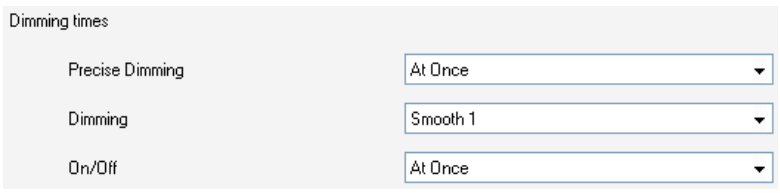
Smooth dimming from/to values other than 0%-100% (on to off) is also performed at the same speed, so the time needed to carry it out will always be lower than that parameterized under "Smooth Dimming Time".

✓ *Example:*

Suppose that 10 seconds ("100") is the parameterized value for the "Smooth dimming time 1" field. A global switch-on order is then sent when the output channel is off, so it will take 10 seconds to achieve the maximum brightness level (if the "Dimming" parameter has been configured as "Smooth 1"). If the channel was already at a brightness percentage of for instance 50%, the time taken to reach full brightness (100%) will be 5 seconds (one half of the 10 seconds parameterized).

Three more parameters are shown next, grouped as "Dimming times":

- **Precise Dimming:** this box can be used to define whether transitions ordered through both the general and the channel-dependent **Precise Dimming** objects, and also through the 3-byte **Color RGB** object (in other words, dimming orders performed by sending a certain luminosity value, in percentage) should be **Immediate**, **Smooth 1** (it will be a progressive transition, according to the defined Smooth Time 1) or **Smooth 2** (a progressive transition, according to Smooth Time 2).



- **Dimming:** it is possible to define from here whether step-by-step transitions (i.e., through the 4-bit **Dimming** objects, both the global one 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** (a progressive transition as well, but according to the defined Smooth Time 2).

Note: *the most common procedure for parameterizing this kind of dimming consists in linking button pushes to the sending of a certain value (typically, a 100% step) through the Dimming object. Since the purpose of this kind of dimming is letting the user perform progressive light increases/decreases, only smooth dimming makes sense here, hence avoiding that such step of 100% results excessively fast, making it impossible for the user to stop the dimming process when the current light level is considered adequate.*

- **On/Off:** permits defining the transition type (immediate, Smooth 1 or Smooth 2) that will apply for a light switch-on or switch-off.

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

- **On Light Level:** through this object, it is possible to set the desired level of luminosity when an On order is received through the global On/Off object. This can be the maximum available ("**100%**"), or the same as before the last switch-off ("**Previous**"). On the very first switch-on, the luminosity will be set at 100% (and the color will be white).

Note: *on a global switch-on, the strips recover the color 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 color and full luminosity), in the particular case of performing the switch-on after having set, accidentally or not, all the three channels to zero through their respective dimming (or precise dimming) objects, the acquired color on the switch-on will as well be white (and the luminosity, maximum).*

✓ *Example:*

The following sequence of actions – effects, assumed for an "On Light Level" parameterized as "Previous", is an example of the implications of the above note:

#	Action	Effect
1	*Download*	-
2	*Global switch-on order*	***White** (luminosity = 100%)*
3	*Direct Color (*) = 12*	***Green** (luminosity = 100%)*
4	*[R] Precise dimming = 5%*	*Level of Red = 5%*
5	*[G] Precise dimming = 5%*	*Level of Green = 5%*
6	*[B] Precise dimming = 5%*	*Level of Blue = 5%*
7	*[R] Precise dimming = 0%*	*Level of Red = 0%*
8	*[G] Precise dimming = 0%*	*Level of Green = 0%*
9	*[B] Precise dimming = 0%*	*Level of Blue = 0% (No light at all)*
10	*Global switch-off order*	-
11	*Global switch-on order*	***White** (luminosity = 100%) (**)*

(*) Refer to Section 3.3.2 for the Direct Color object.

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

Table 3.2. Example of an exception in the global switch-on with “Previous” luminosity

- **Max Light level (%)**: defines the maximum effective brightness, in percentage (from 5 to 100%), to be applied to the channels when a dimming order is received. If this parameter is set to a value other than 100%, a proportional reduction in the luminosity will apply. However, for coordination and update purposes, LUMENTO X3 will always send to the KNX bus the theoretical luminosity value, between 0% and 100%.

✓ *Example:*

Suppose that “70%” is the value of this parameter. In that 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 (RGB):** after enabling this option ("Yes"), 9 new communication objects will be shown for activating/deactivating each of the channels independently ("[Ch] On/Off") and for dimming the brightness levels of each of them ("[Ch] Dimming" and "[Ch] Precise dimming").

If after sending a control order over an individual channel (precise dimming, step by step dimming, stop dimming, etc.) a global dimming order is sent (precise or step by step, see section 3.1), the last established proportions will be taken as the new base color over which the global dimming will be carried out.

✓ *Example:*

Suppose starting with the base RGB color (20, 0, 60). A precise dimming order over the blue channel is sent ("[B] Precise Dimming"=50%), so the new base color will be (20, 0, 128). If a global dimming over the 3 channels (for example, "Precise dimming=25%") is then carried out, these new color components will be taken as the starting point, so the resulting color will be (10, 0, 64).

Error identification: this option displays two 1-bit communication objects to inform about anomalous behaviours that may appear when LUMENTO X3 is working:

- "Error: External voltage". Object through which LUMENTO X3 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/Reverse polarity indicator, which turns on in orange). When LUMENTO X3 detects any of these anomalous situations, it sends the value "1" through this object. When the event finishes, it sends a "0".

- "Error: Overheating". Object through which LUMENTO X3 notifies it is exposed to an excessive temperature (**higher than 90ºC**), by sending the value "1". In that moment, LUMENTO X3 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 X3 will send the value "0" through this object, thus marking 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 X3 will directly switch its output off, 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.*

3.3. FUNCTIONS

LUMENTO X3 RGB offers a set of different functions (see figure 3.3), which may be selectively enabled, depending on the needs and requirements of the installation.

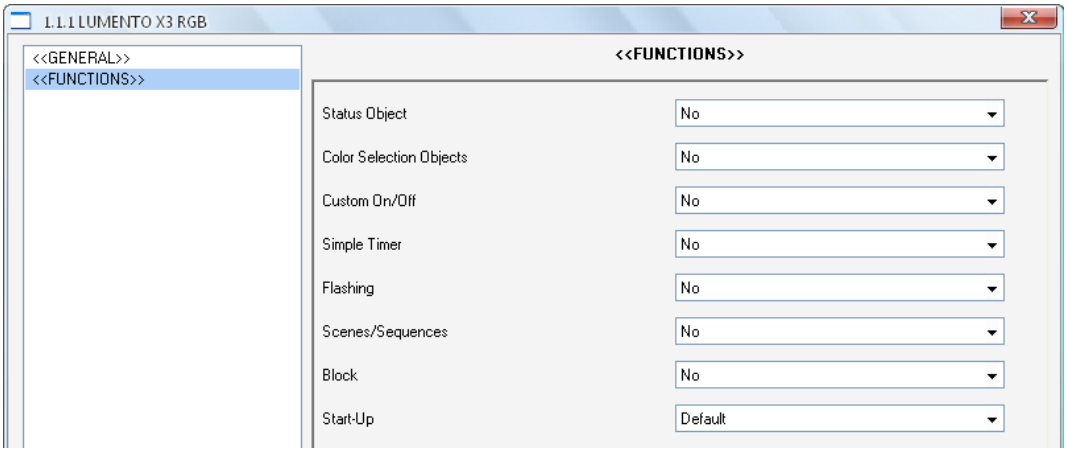


Figure 3.3. “Functions” screen, by default

Every available function is detailed next.

3.3.1. STATUS OBJECTS

This function allows enabling the 1-bit status object ("On/Off Status") and the 1-byte status object ("Luminosity Status"), responsible for reporting the overall brightness status of the output at any time, thus updating the status of the devices in the KNX installation, if required.

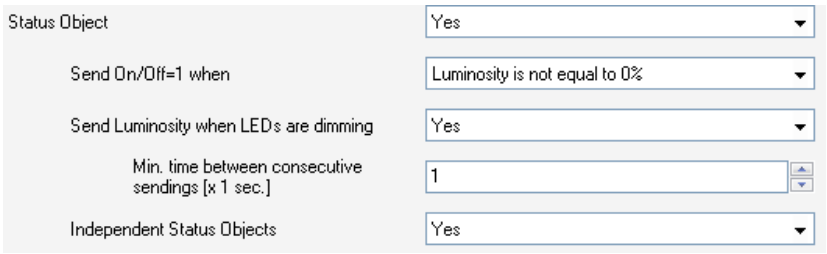


Figure 3.4. Status objects

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

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

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

- **Send Luminosity when LEDs are dimming:** this option allows selecting whether to send the brightness status of the output (through the "Luminosity (Status)" object) or not (default option). If the status sending during dimming is enabled, the following option will appear:

  - **Minimum time between status sending**: sets the minimum time (in seconds) between consecutive sendings of the brightness status through the "Luminosity (Status)" object. This limitation applies to smooth dimming.

- **Independent status objects:** this option activates 6 additional communication objects which permit knowing the status of each channel, independently and at any time. These objects are "[Ch] On/Off (Status)" and "[Ch] Luminosity (Status)", whose behaviour is analogous to that of the general status objects.

3.3.2. COLOR SELECTION OBJECTS

Enabling this function causes the activation of two new communication objects: “Direct color” (1 byte) and “Color shift” (1 bit).

- **Direct color:** it is a 1-byte communication object that permits directly selecting one of the 22 colors of the predefined palette. It works similarly to “Scene” objects.

Every predefined color is associated to a certain number (from 1 to 22), as seen in table 3.3. If one of these values (decremented by 1) is written to the "Direct color" object, the LED module will turn to the corresponding color **immediately**, regardless of the global dimming types (At once, Smooth 1 or Smooth 2) parameterized from the General screen.

Scene (Value)	Color	R	G	B
1 (0)	OFF	0	0	0
2 (1)	White	255	255	255
3 (2)	White light	128	128	128
4 (3)	Blue	0	0	255
5 (4)	Blue Light	102	204	255
6 (5)	Blue Navy	0	0	102
7 (6)	Blue Cyan	0	255	255
8 (7)	Blue Turquoise	0	255	77
9 (8)	Blue Lavender	128	128	255
10 (9)	Green	0	255	0
11 (10)	Green Light	128	255	51
12 (11)	Green Dark	0	102	0
13 (12)	Green Lime	128	255	0
14 (13)	Red	255	0	0
15 (14)	Red Pink	255	102	77
16 (15)	Red Dark	102	0	0
17 (16)	Red Magenta	255	0	255
18 (17)	Red Fuchsia	255	26	51
19 (18)	Yellow	255	255	0
20 (19)	Orange	255	51	0
21 (20)	Lilac	255	128	128
22 (21)	Purple	170	0	255

Table 3.3. Predefined colors in LUMENTO X3 RGB

Color shift: this is a 1-bit object that lets the user start an automatic scan over the entire color palette, making it possible to stop it afterwards, as soon as the desired color is being shown. 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.

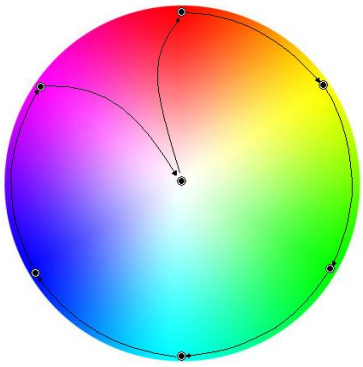


Figure 3.5. Color scan

The color tour takes place according to the order shown by Figure 3.5, however not necessarily the starting point will always be the same; instead, the closest point to the current color will be adopted as the initial stage. The complete cycle takes 15 seconds and it does not affect the current luminosity at all, so no color scan will take place if all the channels have been set to 0%.

Note: *the color scan will be interrupted not only on the reception of the value "0" through the "Color 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" (1 byte).*

3.3.3.CUSTOM ON/OFF

This function offers, once enabled, up to four additional ON/OFF controls, independently customizable.

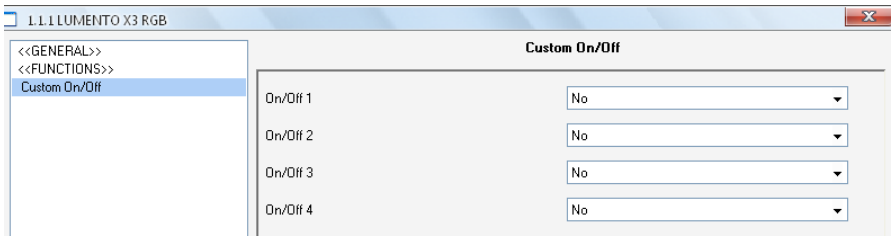


Figure 3.6. Custom On/Off

The following parameters can be configured for each of these custom ON/OFF controls:

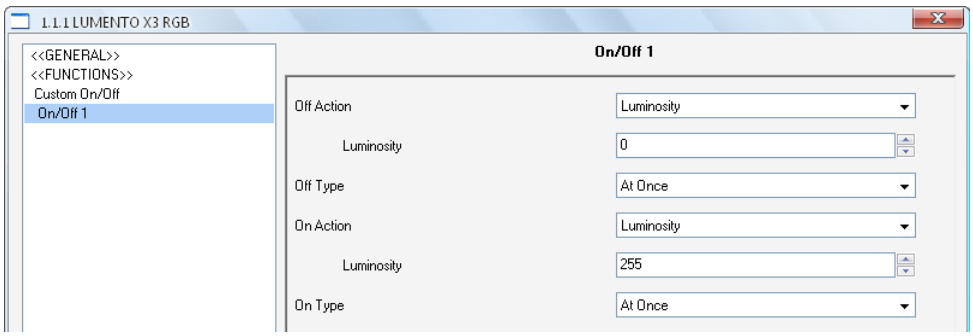


Figure 3.7. Custom On/Off configuration

- **Off action:** sets the action to be executed over the LED module when LUMENTO X3 receives the value “0” through the 1-bit “Custom On/Off X” communication object. This can consist in a change in the luminosity (“Luminosity”, which will display a new parameter destined to set the desired value) or in a change in the active color, being possible to select a specific color from the predefined palette (“Predefined Color”, which will display a drop-down list with all the possible values; see Table 3.3) or a manually defined color (“RGB Color”, which will permit inserting numeric values –from 0 to 255– for every color component: R, G and B).

- **Off type:** sets the desired dimming type for the switch-off of the LED module: at once, smooth 1 and smooth 2.

- **On action:** sets the action that will be executed on the LED module when LUMENTO X3 receives the value "1" through the 1-bit object "Custom On/Off X". Analogously to the

"Off action" explained above, a luminosity change or a color change will be available, being also possible in the latter to define a state-recovery switch-on ("**Last color**"). This way, whenever LUMENTO X3 receives a "0" through the corresponding "Custom On/Off" object, it will save into memory the value of the current color of the LED module. After that, when the ON order arrives ("Custom On/Off = 1"), LUMENTO X3 will set the LED module back again to the same color.

✓ *Example:*

Suppose the following configuration for Custom On/Off number 2: Off Action = Blue; On Action = Last. The LED module is lighting in yellow when LUMENTO X3 receives the switch-off order (value "0") through the "Custom On/Off 2" object. The module will then light in blue (Off Action), prior to which LUMENTO X3 stores in memory the color of the LED module that was active before the switch-off. When it then receives the switch-on order ("Custom On/Off 2=1"), the LEDs will light again with the last color stored before the switch-off (yellow).

- **On type:** sets the desired dimming type for the switch-on of the LED strip: At once, Smooth 1 or Smooth 2.

3.3.4. SIMPLE TIMER

This function allows switching on the LED module connected to the output of LUMENTO X3 and a later automatic (timed) switch-off, being it also possible to select delays. Apart from the delays, it is also possible to set, by parameter: the length, the color and the switch-on type.

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

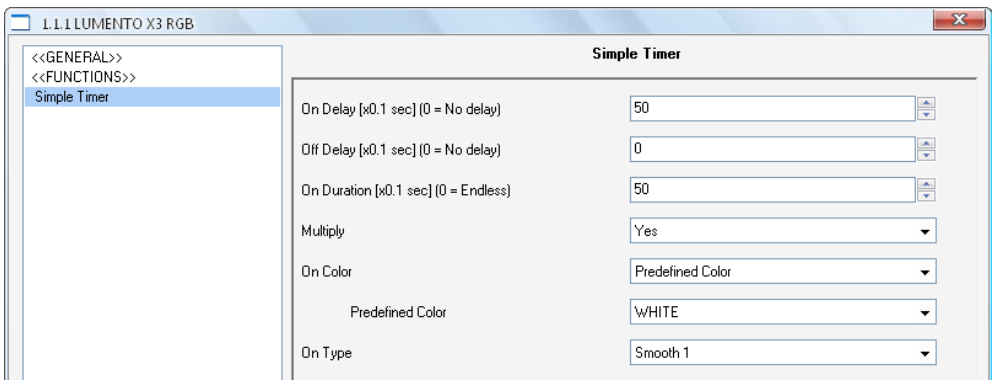


Figure 3.8. Simple timer

- **On Delay:** this parameter sets the time LUMENTO X3 will wait since the reception of the Timer ON order (“Simple Timer = 1”) and the actual switch-on of the LED module. 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 at 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 module. Works similarly to the On Delay.

- **On Duration:** this parameter sets the time the LED module will stay on before switching off again. A 0 in this field means endless, i.e., no timing is applied to the switch-on (the LED module behaves as if it had received an ON order).

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

- When LUMENTO X3 receives a "1" through the "Simple Timer" communication object, an ON order is sent to the output, applying the On Delay (if parameterized). The output stays on depending on the On Duration and then turns off (unless this duration has been parameterized with “0”).

- When LUMENTO X3 receives a "0" through the "Simple Timer" communication object, the output is switched off with the corresponding Off Delay (if parameterized).

- **Multiply:** it allows progressively increasing (multiplying), in execution time, the On Duration or the delays of the output switch-on/off orders. I.e., when this function has been enabled, LUMENTO X3 multiplies the defined intervals as many times as the value "1" or "0" are received through the "Simple Timer" object. Two situations are distinguished:

  - **No multiply:** if during a timed switch-on LUMENTO X3 receives a "1" through the "Simple Timer" object, the time count (either the delay or the duration, depending on the current stage) is restarted.

  - **Multiply:** the timing applied to the controller output is multiplied by "n", being "n" the number of times the order is received through the corresponding object before the time parameterized for the current stage ends.

- **On Color:** sets the color desired in the LED module while the timed ON status is active. Either a predefined color (see Table 3.3) or a customized color (by manually configuring each of the RGB color components) can be chosen.

- **On type:** sets the dimming type to be applied to the timed switch-on of the LED module, being the possible options: at once, smooth 1 and smooth 2.

3.3.5. FLASHING

This function allows executing **ON-OFF-ON-OFF sequences**, where it is possible to parameterize the length of the ON/OFF switches applied to the LED module. Moreover, the number of repeats can be set by parameter, as well as the color for the switch-on and the final color of the LEDs after the last repetition.

The LED module starts blinking when LUMENTO X3 receives a "1" through the "Flashing" object and stops when it has executed all the configured repetitions (endless repetition is possible by setting the value “0” in the corresponding box, as shown later). It is possible to end 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 X3 receives a new order to start the flashing sequence ("Flashing" = 1), it will be reset no matter what the current execution stage is.

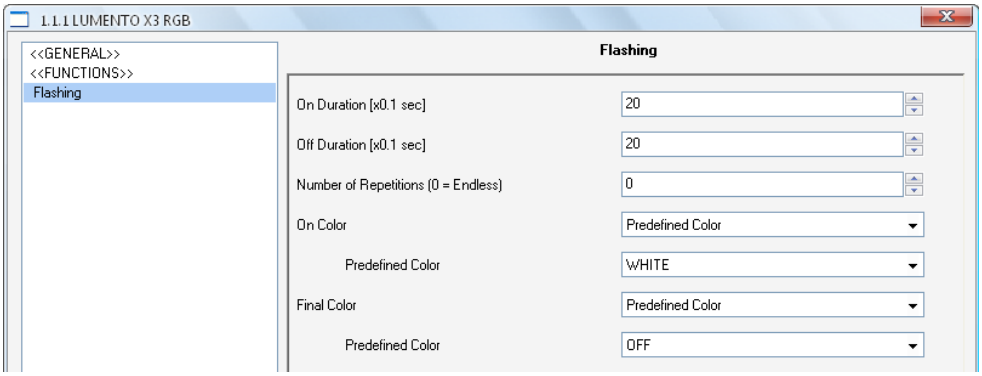


Figure 3.9. Flashing

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

- **On Duration:** sets the length of “ON” steps of the flashing sequence, i.e. the time the output will remain on before turning off again.

- **Off Duration:** sets the length of “OFF” steps of the flashing sequence, i.e. the time the output 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 active. 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:** sets the color desired in the LED module during the “on” stages. Either a predefined color (see Table 3.3) or a customized color (by manually configuring each of the RGB color components) can be chosen.

- **Final color:** sets the color desired in the LED module after the last flashing repetition finishes, or when the "Flashing=0" order is received. Either a predefined color (see Table 3.3) or a customized color (by manually configuring each of the RGB color components) can be chosen.

3.3.6. SCENES/SEQUENCES

This function allows defining different scenes, which consist in a specific static 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, allowing re-executing the last sequence played (by writing the value "1") or stopping the current sequence in execution ("0").

Note: *The “Start/Stop Sequence” 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 first one that was parameterized will be executed, unless it is of the type "Fixed Color"; in such case the first one different to this type will be executed.*

LUMENTO X3 allows configuring up to 10 scenes/sequences, which can be individually enabled from “Scenes/Sequences” in ETS.

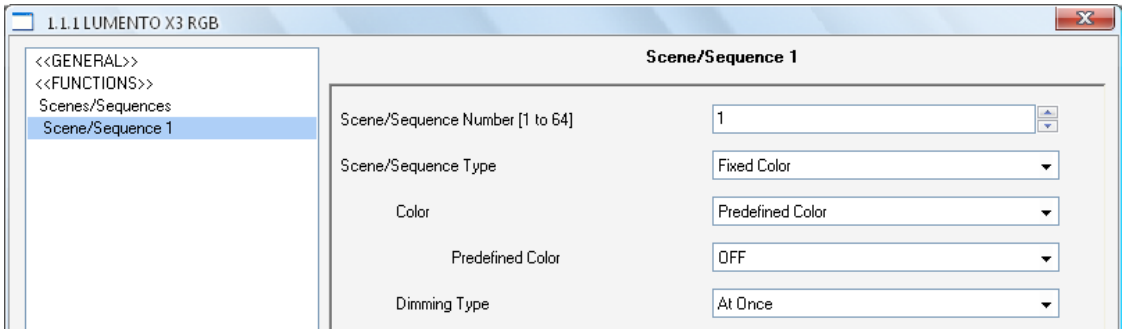


Figure 3.10. Scenes

For each of them the following configurable fields are available:

- **Scene/Sequence number:** indicates the scene/sequence identifying number (from 1 to 64) on whose reception (decreased by 1, according to the KNX standard) through the “Scenes/Sequences” object the controller output will react.

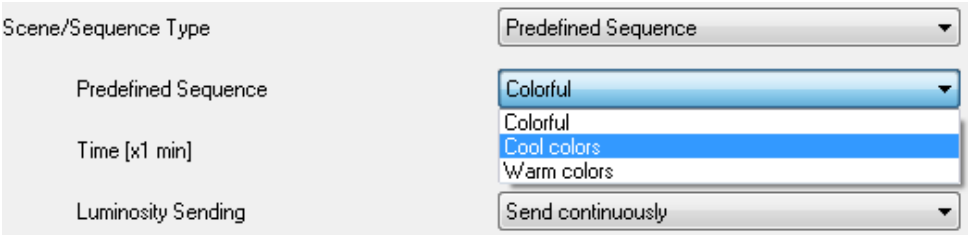
- **Scene/Sequence type:** selects the desired action for each enabled scene/sequence:

  - **Fixed color.** The scene will consist in setting the LED module to a specific color when the "Scenes/Sequences" object is received with the configured scene number. Either a predefined color (see Table 3.3) or a customized color (by manually configuring each of the RGB color components) can be chosen. The dimming type can also be selected (At once, Smooth 1 or Smooth 2).

    If "Fixed color" is selected, besides running the scene it will be also possible to **save** it: if LUMENTO X3 receives an order to save the scene, the current color of the LEDs will be saved, so when the same scene is executed again, the color shown will be the saved one (and not the originally parameterized in ETS).

  - **Luminosity.** The scene execution will in this case consist in changing the luminosity level, with no change to the active color. 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).

  - **Predefined sequence.** 3 different preconfigured sequences are available in LUMENTO X3: Colorful, Cool colors and Warm colors.



Every sequence consists of 5 steps (smooth transitions between different colors) of a certain duration. They behave **cyclically**, so when the last step of the sequence finishes, it starts over again (from the first step), automatically. The default duration of every cycle is 1 minute, but it can be modified through the "**Time**" (t) textbox, by writing a value in the range [1...255], in minutes.

Note: *LUMENTO X3 will proportionally modify the action time of every step of the sequence in order to adjust it to the new parameterized cycle time (t).*

The **Luminosity sending** field is intended to set when LUMENTO X3 will send the KNX bus the brightness status of the output, being the following options available:

- Send continuously: the brightness level will be continuously sent through the "Luminosity (Status)" object (**only if** the "Send Luminosity when LEDs are dimming" parameter has been enabled from the Functions screen), respecting the minimum time between sendings.

- Don´t send: No matter if the status sending option is enabled or not, the brightness status during the sequence execution will not be sent to the KNX bus.

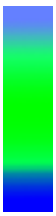
The next three tables show the predefined color patterns (and the action times) of the three sequences:

Sequence 1: "Colorful"

Step	Color (RGB)	Action T.
1	Red (255/0/0)	t/5
2	Green (0/255/0)	t/5
3	Blue (0/0/255)	t/5
4	Magenta (255/0/255)	t/5
5	Yellow (255/255/0)	t/5

Sequence 2: "Cool colors"

Step	Color (RGB)	Action T.
1	Blue1 (100/128/255)	t/5
2	Green1 (20/255/60)	t/5
3	Green (0/255/0)	t/5
4	Green2 (0/255/77)	t/5
5	Blue (0/0/255)	t/5



Sequence 3: "Warm colors"

Step	Color (RGB)	Action T.
1	Red (255/0/0)	t/5
2	Magenta (255/0/255)	t/5
3	Pink (255/80/128)	t/5
4	Orange (255/51/0)	t/5
5	Yellow (255/255/0)	t/5

➢ **Custom sequence.** Selecting this option will make it possible to customize sequences of up to 5 steps/actions, by configuring the following general aspects:

- **Cyclic.** "Yes" will define a cyclic sequence (after the last parameterized step, the sequence will start executing again, from the first parameterized step), while "No" will define a non-cyclic sequence (in such case, there is also the possibility of triggering –after the last step of the current sequence– another parameterized sequence).

- **Luminosity sending:** can be set to Send continuously (same behaviour as for Predefined sequences; this option should have been parameterized from the General screen) or to Send when sequence ends (here, the brightness level of the output will be sent to the bus once the last step of the sequence finishes, no matter if the sending of the status during the dimming has been enabled or not from the General screen).

For every step, the following parameters can be configured:

- **Color**. Sets the color of the LED module (either RGB or predefined).

- **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, switching from the last color to that defined in the corresponding step by taking as much time as defined in the "Time" box.

- **Time**. Sets the time length of the step (action time), in seconds.

The steps (or actions) will be executed in order, i.e., when LUMENTO X3 receives the Scene number that triggers the sequence, the first configured step will be executed,

and so on. 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 3.11, where the three first steps of Sequence 1 have been parameterized.

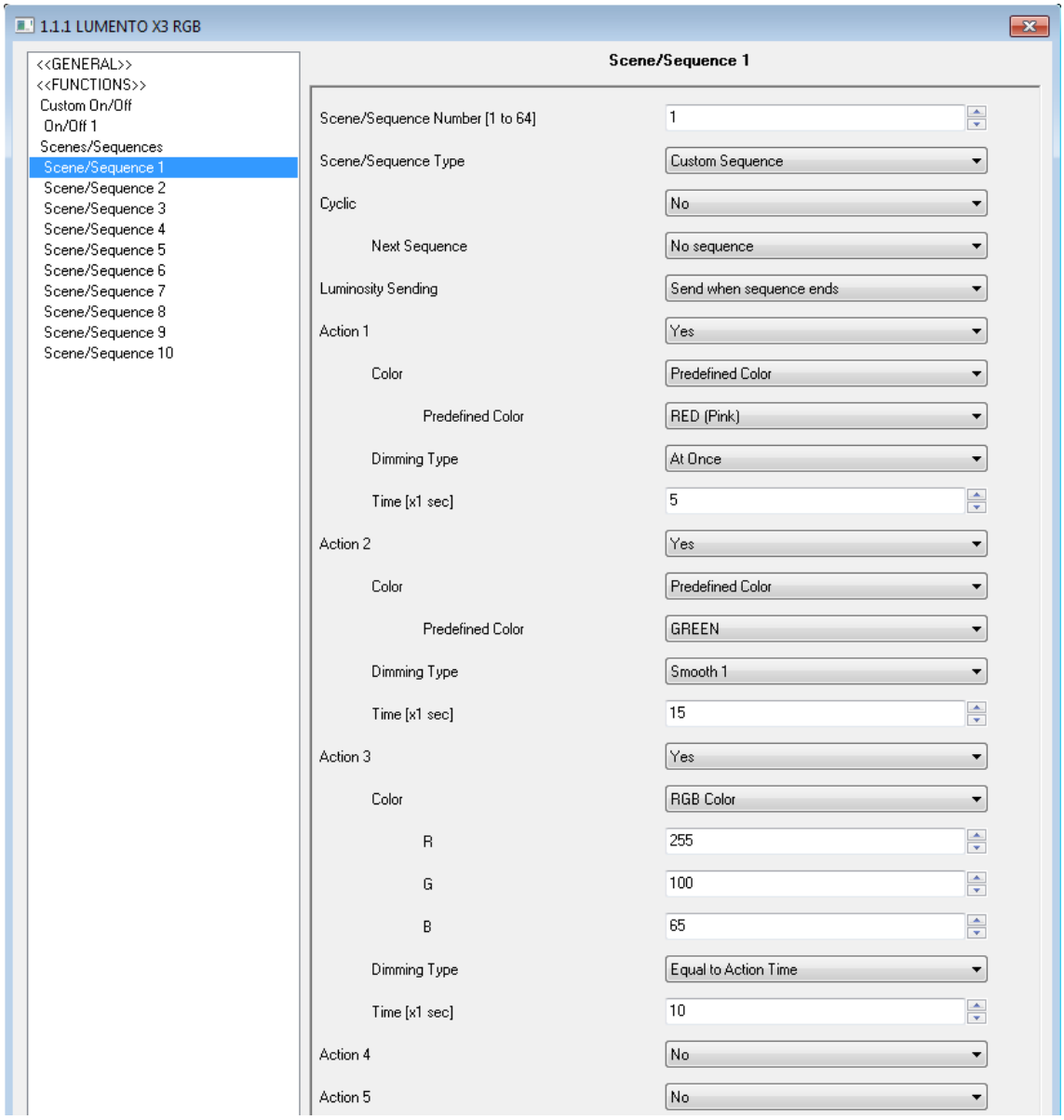


Figure 3.11. Custom sequence example

3.3.7. BLOCK

This function makes it possible to lock the LED controller; i.e., to disable the control.

LUMENTO X3 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 module will maintain the brightness value it had when the lock order arrived.

Under the lock status, any order received from the KNX bus will be ignored, i.e., it will not be performed by the output.

LUMENTO X3 will unlock the output when the value "0" arrives through the "Block" object. The output will also then maintain the color it had before receiving the lock order. Any color/luminosity change received during the lock status will not be taken into account, not even on the unlock event.

3.3.8. START-UP

A default or custom start-up configuration can be selected.

If the default configuration is chosen, the LEDs will stay off after a download from ETS. On bus voltage recovery, the color of the LEDs will be the last one they had before the bus power failure.

If a custom configuration is chosen, it is possible to select by parameter the desired status of the LED module on bus voltage recovery and after a download from ETS.

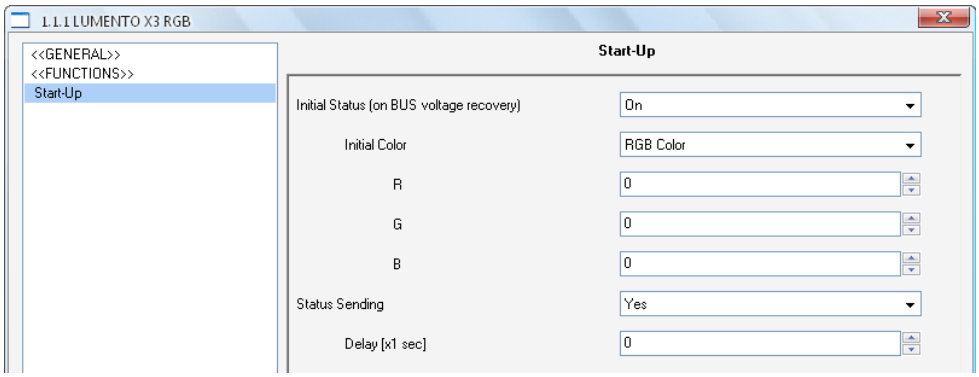


Figure 3.12. Start-up

The following parameters can be configured:

- **Initial Status (on bus voltage recovery):** sets the initial status the LED module will adopt when the bus power failure situation ends or after a download from ETS. It is possible to select one of these statuses:

  - **Last:** the LED module will recover the same color and brightness level it 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, lighting in the color defined for the "Initial Color" parameter, which can be an RGB color or a predefined color (see Table 3.3).

- **Status sending:** by enabling this parameter ("Yes"), the status of the LED module will be sent to the KNX bus on bus power recovery or after a download**,** thus allowing the update of the status of the other devices in the KNX installation that may need it. When enabled, a new drop-down box is shown: "Delay", for setting the time (in seconds) LUMENTO X3 waits until it sends the status objects. To get an immediate sending (no delay), the value “0” should be typed in for this field. The start-up status sending is performed through the "On/Off (Status)" and "Luminosity (Status)" communication objects.

Note: bus failures do not turn off the LEDs, unless the external power supply is also interrupted.

ANNEX I. COMMUNICATION OBJECTS

SECTION	NUMBER	SIZE	IN/OUT	FLAGS	VALUES			NAME	DESCRIPTION
					RANGE	1st TIME	RESET		
RGB CHANNELS	0	1 bit	I	W	0/1	Irrelevant	Irrelevant	[R] ON/OFF	0=Off; 1=On
	1	1 bit	I	W	0/1	Irrelevant	Irrelevant	[G] ON/OFF	0=Off; 1=On
	2	1 bit	I	W	0/1	Irrelevant	Irrelevant	[B] ON/OFF	0=Off; 1=On
	3	4 bits	I	W	0-15	Irrelevant	Irrelevant	[R] Dimming	4-bits dimmer control
	4	4 bits	I	W	0-15	Irrelevant	Irrelevant	[G] Dimming	4-bits dimmer control
	5	4 bits	I	W	0-15	Irrelevant	Irrelevant	[B] Dimming	4-bits dimmer control
	6	1 byte	I	W	0-100%	Irrelevant	Irrelevant	[R] Precise Dimming	1 byte dimmer control
	7	1 byte	I	W	0-100%	Irrelevant	Irrelevant	[G] Precise Dimming	1 byte dimmer control
	8	1 byte	I	W	0-100%	Irrelevant	Irrelevant	[B] Precise Dimming	1 byte dimmer control
GENERAL	9	4 bits	I	W	0-15	Irrelevant	Irrelevant	Dimming	4-bits dimmer control
	10	1 byte	I	W	0-100%	Irrelevant	Irrelevant	Precise Dimming	1 byte dimmer control
	11	1 bit	I	W	0/1	0	Last	ON/OFF	0=Off; 1=On
	35	3 bytes	I	W	0-100% (x3)	0	Last	RGB Control	3 bytes RGB ctrl
STATUS OBJECTS	12	1 bit	O	RT	0/1	0	Last	[R] ON/OFF (Status)	0=Off; 1=On
	13	1 bit	O	RT	0/1	0	Last	[G] ON/OFF (Status)	0=Off; 1=On
	14	1 bit	O	RT	0/1	0	Last	[B] ON/OFF (Status)	0=Off; 1=On

SECTION	NUMBER	SIZE	IN/OUT	FLAGS	VALUES			NAME	DESCRIPTION
					RANGE	1st TIME	RESET		
STATUS OBJECTS	15	1 byte	O	RT	0-100%	0	Last	[R] Luminosity (Status)	0-100%
STATUS OBJECTS	16	1 byte	O	RT	0-100%	0	Last	[G] Luminosity (Status)	0-100%
	17	1 byte	O	RT	0-100%	0	Last	[B] Luminosity (Status)	0-100%
	18	1 bit	O	RT	0/1	0	Last	ON/OFF (Status)	0=Off; 1=On
	19	1 byte	O	RT	0-100%	0	Last	Luminosity (Status)	0-100%
CUSTOM ON/OFF	20-23	1 bit	I	W	0/1	Irrelevant	Irrelevant	Custom On/Off x [x=1...4]	0=Off; 1=On
SIMPLE TIMER	24	1 bit	I	W	0/1	Irrelevant	Irrelevant	Simple timer	0=Deactivate; 1=Activate
FLASHING	25	1 bit	I	W	0/1	Irrelevant	Irrelevant	Flashing	0=Deactivate; 1=Activate
SCENES/SEQUENCES	26	1 byte	I	W	0-64	Irrelevant	Irrelevant	Scenes/Sequences	Scene/Sequence value
	27	1 bit	I	W	0/1	Irrelevant	Irrelevant	Start/Stop Sequence	0=Stop; 1=Start
BLOCK	28	1 bit	I	W	0/1	0	Last	Block	0=Unblock; 1=Block
DIMMING SPEED	29-30	1 byte	I/O	RW	0-100%	0%	Last	Dimming Speed (1 or 2)	0%=Min.Speed; 100%=Max.Speed
COLOR SELECTION	31	1 byte	I/O	RW	1-22	Irrelevant	Irrelevant	Direct Color	Color number (Scene 1-22)
	34	1 bit	I	W	0/1	Irrelevant	Irrelevant	Color Shift	0=Stop; 1=Start
ERROR OBJECTS	32	1 bit	O	RT	0/1	0	0	Error: External voltage	0=Normal; 1=Low Ext. Voltage
	33	1 bit	O	RT	0/1	0	0	Error: Overheating	0=Normal; 1=Overheating

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