



## Technical application guide

### BackLED Plus/Basic G15 and BoxLED<sup>®</sup> Plus G15

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# 1 Product overview

## 1.1 BackLED Plus G15



BackLED S Plus G15



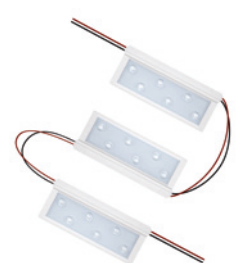
BackLED M Plus G15



BackLED L Plus G15



BackLED XL Plus G15



BackLED DS Plus G15

## 1.2 BackLED Basic G15



BackLED XS Basic G15



BackLED M Basic G15



BackLED L Basic G15

## 1.3 BoxLED® Plus G15



BoxLED® XS Plus G15



BoxLED® eco M Plus G3



BoxLED® L Plus G15



BoxLED® Side Plus

## 2 Electrical properties

### 2.1 Electrical connections

We recommend the following cable lengths and cable cross-sections for the electrical connections between the LED chains and the OPTOTRONIC® LED drivers.

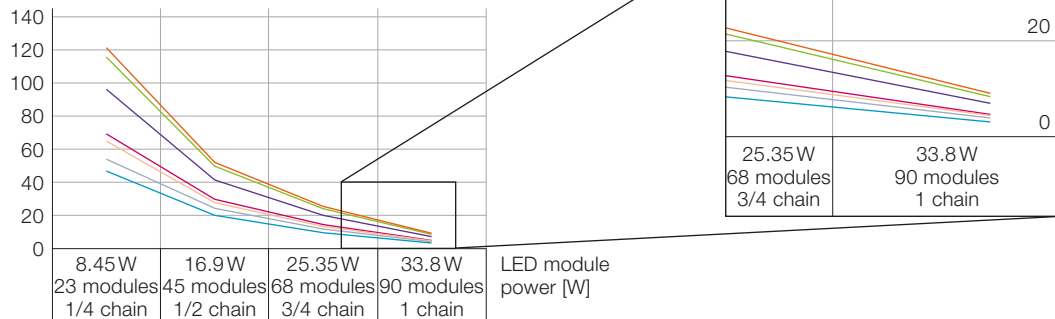
#### 2.1.1 Recommended cable lengths

##### BackLED Plus G15

###### BackLED S Plus G15 white, red

■ AWG20/0.57 mm<sup>2</sup> ■ AWG18/0.79 mm<sup>2</sup> ■ AWG16/1.23 mm<sup>2</sup>  
 ■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup> ■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>

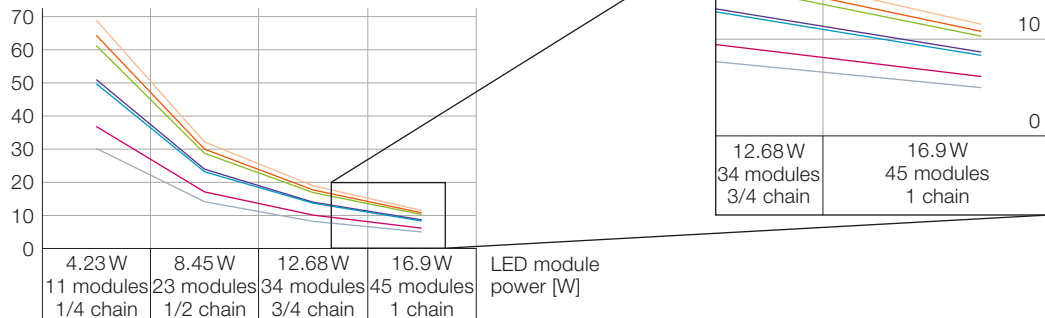
Maximum secondary cable length [m]



###### BackLED S Plus G15 green, blue

■ AWG20/0.57 mm<sup>2</sup> ■ AWG18/0.79 mm<sup>2</sup> ■ AWG16/1.23 mm<sup>2</sup>  
 ■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup> ■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>

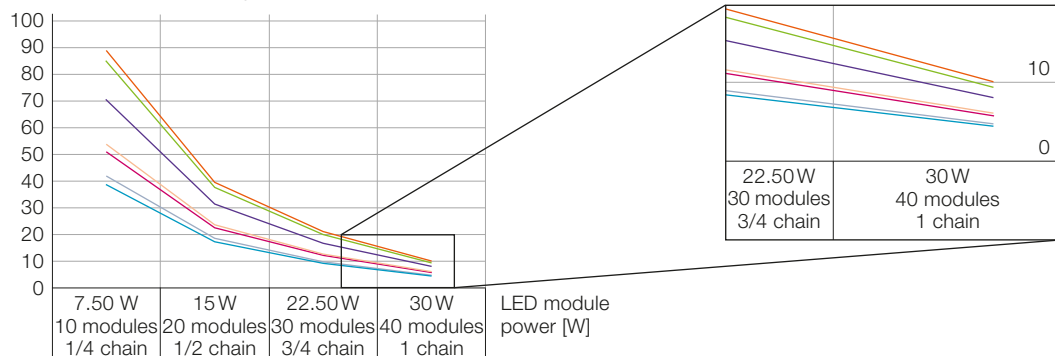
Maximum secondary cable length [m]



###### BackLED M Plus G15 white

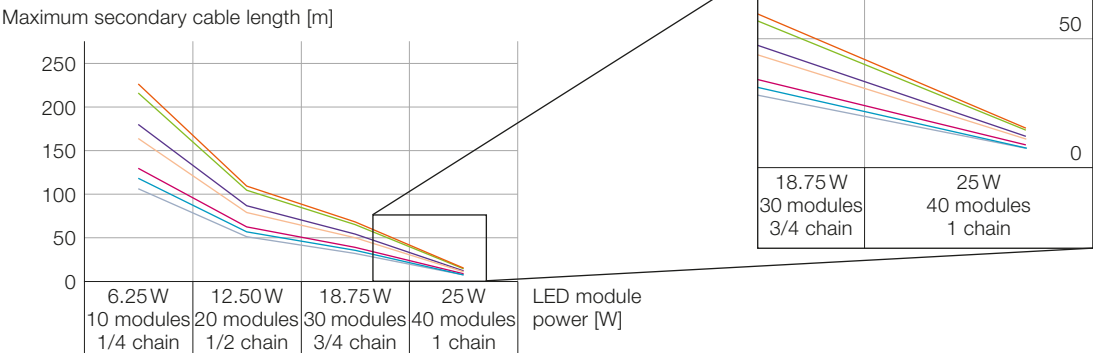
■ AWG20/0.57 mm<sup>2</sup> ■ AWG18/0.79 mm<sup>2</sup> ■ AWG16/1.23 mm<sup>2</sup>  
 ■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup> ■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>

Maximum secondary cable length [m]



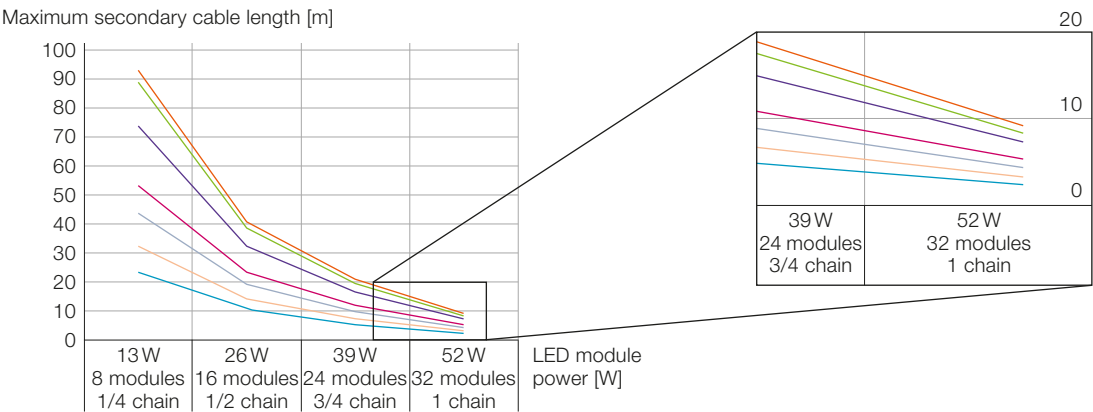
BackLED M Plus G15 red

■ AWG20/0.57 mm²   ■ AWG18/0.79 mm²   ■ AWG16/1.23 mm²  
■ AWG14/2.08 mm²   ■ AWG13/2.62 mm²   ■ 1.5 mm²   ■ 2.5 mm²



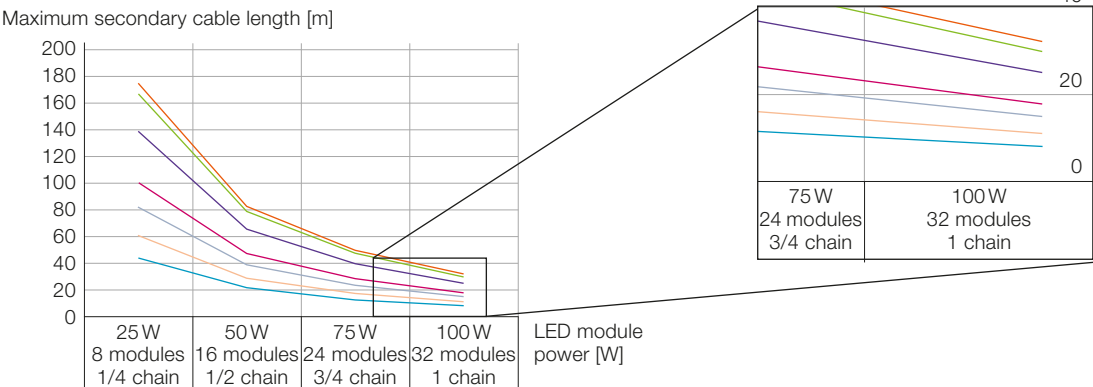
BackLED L Plus G15

■ AWG20/0.57 mm²   ■ AWG18/0.79 mm²   ■ AWG16/1.23 mm²  
■ AWG14/2.08 mm²   ■ AWG13/2.62 mm²   ■ 1.5 mm²   ■ 2.5 mm²



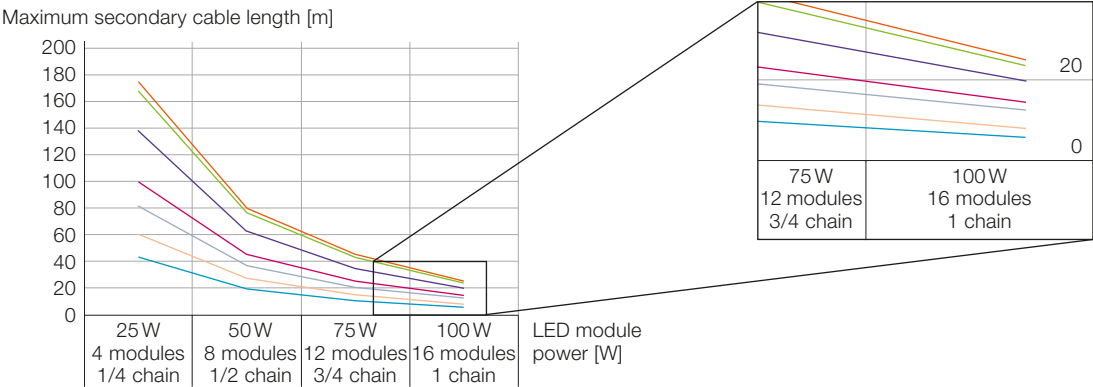
BackLED XL Plus G15

■ AWG20/0.57 mm²   ■ AWG18/0.79 mm²   ■ AWG16/1.23 mm²  
■ AWG14/2.08 mm²   ■ AWG13/2.62 mm²   ■ 1.5 mm²   ■ 2.5 mm²



BackLED DS Plus G15

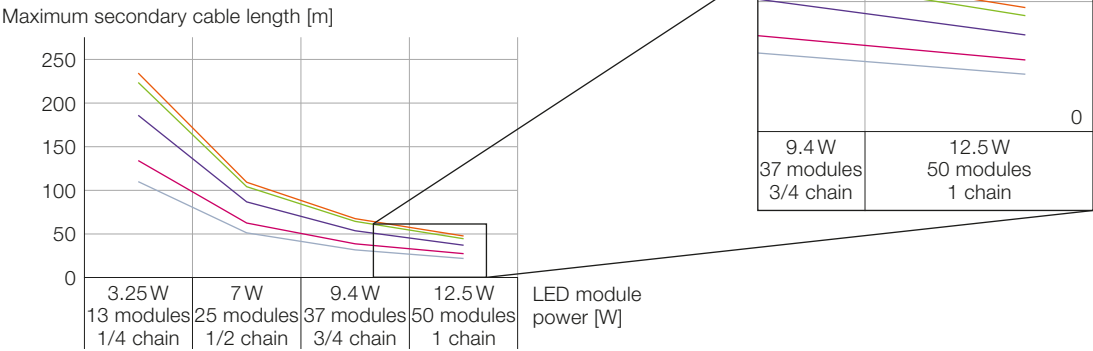
■ AWG20/0.57 mm<sup>2</sup> ■ AWG18/0.79 mm<sup>2</sup> ■ AWG16/1.23 mm<sup>2</sup>  
■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup> ■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>



BackLED Basic G15

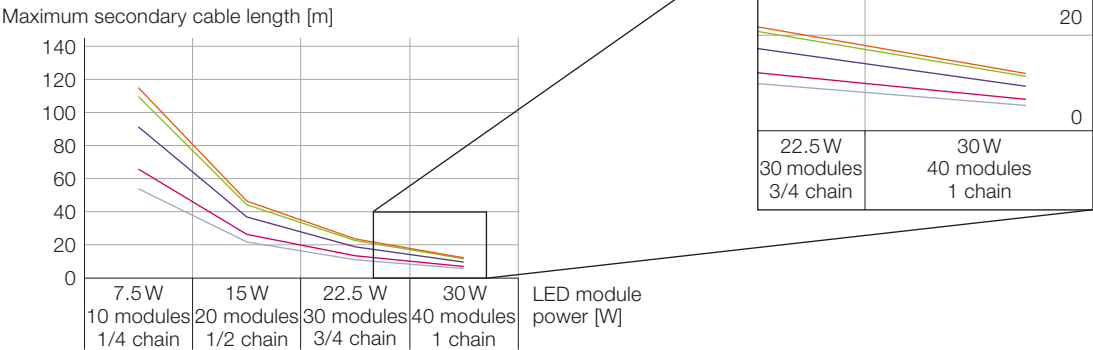
BackLED XS Basic G15

■ AWG16/1.23 mm<sup>2</sup> ■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup>  
■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>



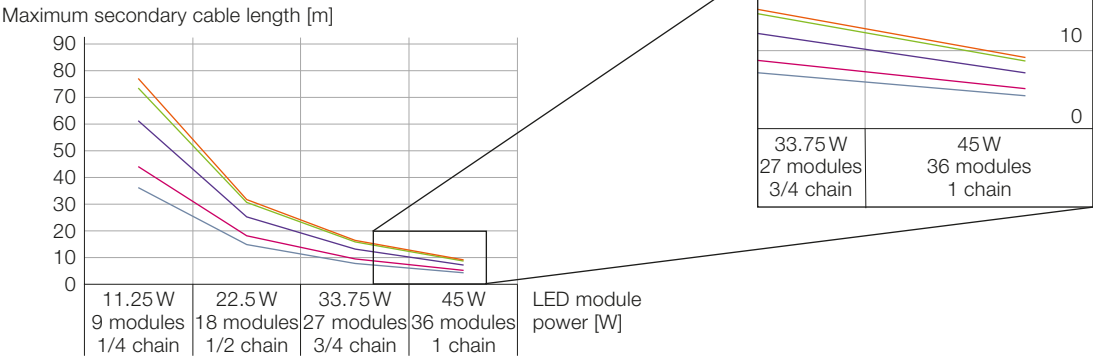
BackLED M Basic G15

■ AWG16/1.23 mm<sup>2</sup> ■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup>  
■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>



BackLED L Basic G15

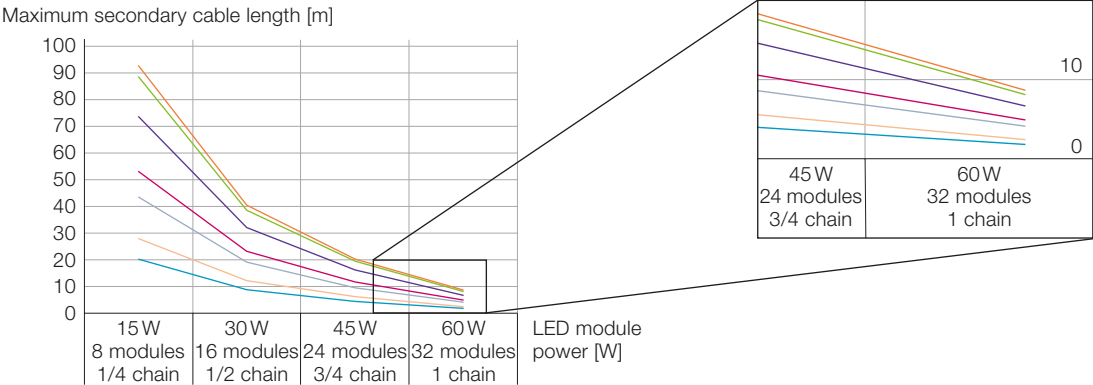
■ AWG16/1.23 mm<sup>2</sup> ■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup>  
■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>



BoxLED® Plus G15

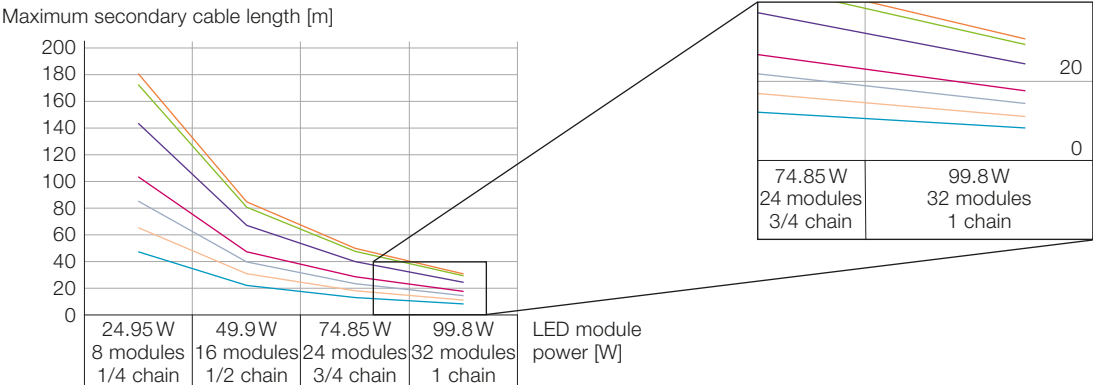
BoxLED® XS Plus G15

■ AWG20/0.57 mm<sup>2</sup> ■ AWG18/0.79 mm<sup>2</sup> ■ AWG16/1.23 mm<sup>2</sup>  
■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup> ■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>



BoxLED® eco M Plus G3

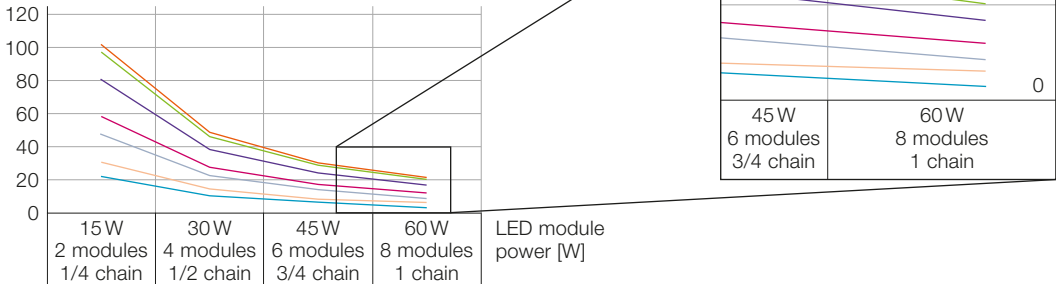
■ AWG20/0.57 mm<sup>2</sup> ■ AWG18/0.79 mm<sup>2</sup> ■ AWG16/1.23 mm<sup>2</sup>  
■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup> ■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>



BoxLED® L Plus G15

■ AWG20/0.57 mm<sup>2</sup> ■ AWG18/0.79 mm<sup>2</sup> ■ AWG16/1.23 mm<sup>2</sup>  
■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup> ■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>

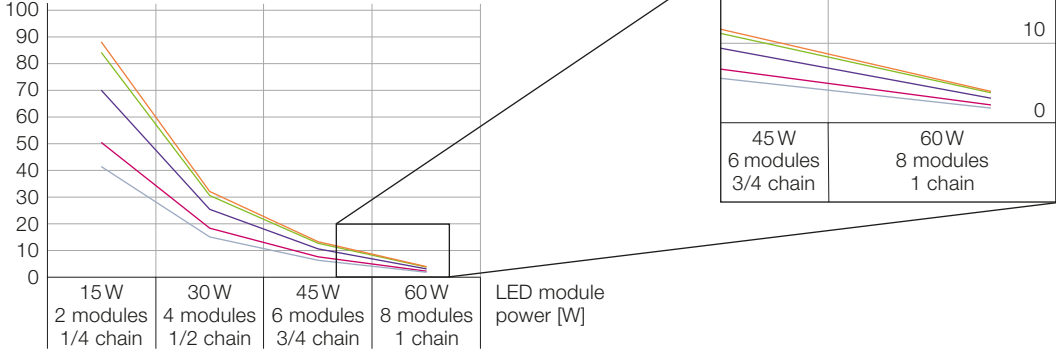
Maximum secondary cable length [m]



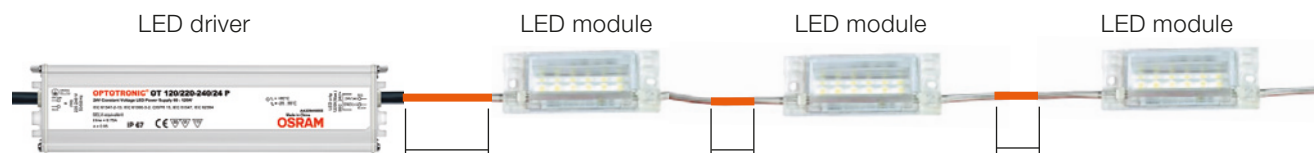
BoxLED® Side Plus

■ AWG16/1.23 mm<sup>2</sup> ■ AWG14/2.08 mm<sup>2</sup> ■ AWG13/2.62 mm<sup>2</sup>  
■ 1.5 mm<sup>2</sup> ■ 2.5 mm<sup>2</sup>

Maximum secondary cable length [m]







Max. secondary length = LED driver – first LED module + wire extension LED module – LED module + ...

#### Disclaimer:

In terms of electromagnetic compatibility (EMC), the maximum permitted cable length is 10 meters (please refer to the technical data sheet of the applied OSRAM OPTOTRONIC® LED driver). Users are responsible to ensure EMC.

#### Please note:

We recommend to use the LED modules only in combination with OSRAM OPTOTRONIC® LED drivers. The maximum secondary length is the maximum cable length between the LED driver and the first LED module of a chain plus the wire extensions between the LED modules (see above).

### 2.1.2 Recommended cable cross-sections

Product	Type of cable	AWG	A [mm <sup>2</sup> ]	Recommended cable cross-section for connecting an LED chain to other LED modules [mm <sup>2</sup> ]
BackLED XL Plus G15	Multi-wire (stranded)	16	1.31	≥ 1.31
BackLED L Plus G15	Multi-wire (stranded)	18	0.82	≥ 0.82
BackLED M Basic G15	Multi-wire (stranded)	20	0.52	≥ 0.52
BackLED S Plus G15	Multi-wire (stranded)	20	0.52	≥ 0.52
BackLED XS Basic G15	Multi-wire (stranded)	24	0.21	≥ 0.21
BackLED DS Plus G15	Multi-wire (stranded)	18	0.82	≥ 0.82
BoxLED L Plus G15	Multi-wire (stranded)	16	1.31	≥ 1.31
BoxLED M Plus G15	Multi-wire (stranded)	16	1.31	≥ 1.31
BoxLED XS Plus G15	Multi-wire (stranded)	18	0.82	≥ 0.82
BackLED L Basic G15	Multi-wire (stranded)	16	1.31	≥ 1.31
BoxLED eco M Plus G2	Multi-wire (stranded)	20	0.52	≥ 0.52
BackLED XS Basic G15	Multi-wire (stranded)	22	0.32	≥ 0.32
BoxLED Side Plus	Multi-wire (stranded)	18	0.785	≥ 0.785

## 2.2 Electrical connectors






### 2.2.1 General

Electrical connectors are manufactured in many different versions, including screw-type terminals, wire nuts, plug connectors and joining terminals (connectors).






- Use only appropriate cables and connectors to link the LED modules to the OPTOTRONIC® LED drivers.
- Electrical terminals must not be used where they may be directly exposed to the weather without adequate protection. For outdoor applications, plug connectors (without moisture protection) must therefore be protected by IP junction boxes or light boxes.
- If you are using plug connectors that do not have IP protection (moisture protection), make sure that the openings are always pointing downwards.

### 2.2.2 Overview of connectors

Among others, the following standard terminals are suitable for the electrical connections between the LED chains and the connections to the OPTOTRONIC® LED drivers.

	Manu- facturer	Reference	Type of cable*	Maximum outer diameter	AWG cable cross-section	Operating temperature	Special properties
	3M	314	Single-wire/ multi-wire	0.082" (2.08 mm)	AWG22–14 (0.34–2.5 mm²)	Max. 105 °C (221 °F)	Sealed against moisture
	WAGO	Series 222	Single-wire/ multi-wire		AWG28–12 (0.09–4.0 mm²)	Max. 85 °C (185 °F)	
	PHOENIX	JBC 2.5/X	Single-wire/ multi-wire		AWG20–14 (0.75–2.5 mm²)		
	3M	316IR	Single-wire/ multi-wire	0.160" (4.064 mm)	AWG22–16 (0.34–1.305 mm²)	Max. 105 °C (221 °F)	UL-listed, standard 486C, UL file E23438
	WAGO	Series 221	Single-wire/ multi-wire		AWG24–12 (0.14–4 mm²)	Max. 105 °C (221 °F)	

\* Not all connectors are suitable for multi-wire and fine-wire conductors. In some cases, therefore, end sleeves must be provided. Please read the manufacturer's instructions.

	BackLED Plus G15			BackLED Basic G15			BoxLED® Plus G15		
	S	M	DS	XS	M	L	XS	M	L
	■	■	■		■	■		■	■
	■	■	■	■	■	■	■	■	■
	■	■	■		■	■		■	■
	■	■	■		■	■		■	■
	■	■	■	■	■	■	■	■	■

## 3 Application overviews for BackLED Plus/Basic G15



### 3.1 Perfect planning with the OSRAM LED deSIGNer

Find the best overall package with the OSRAM LED deSIGNer, easily and quickly, and even for very demanding lighting projects. Just enter some data, and this free software will automatically calculate the required amount of LED modules and LED drivers. Moreover, this tool provides the correct layout of the modules that ensures homogeneous illumination in the given application.

#### Further services:

- Luminance calculation for BackLED products (S, M, L, XL Plus G15; XS, M and L Basic G15)
- Selection of more than 100 acrylic glasses and more than 50 different PVC/woven fabrics
- Can be used to create sales quotes
- Calculation of the required BoxLED® products for light boxes

Start your planning now at [www.osram.com/led-designer](http://www.osram.com/led-designer)  
**LED deSIGNer for “direct backlighting” or LED deSIGNer for “sidelighting”.**

### 3.2 Luminance as a function of transmission: BackLED DS Plus G15

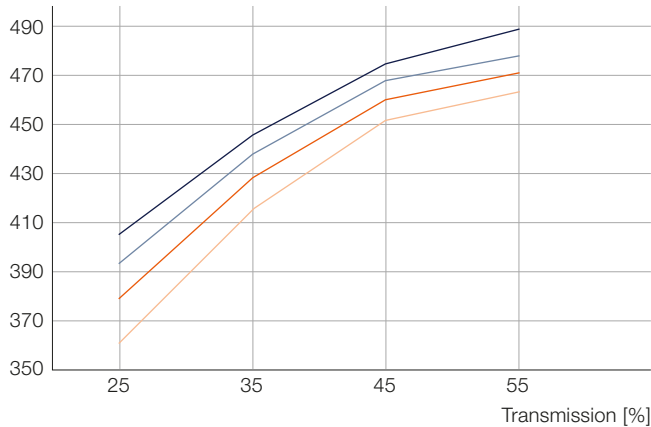
The graphs below show the dependency between the transmission of a light-emitting surface and the resulting luminance at constant module distances of 400 mm (i.e. the distance between the module centers of each module string as well as the distance between parallel module strings).

The luminance can vary depending on the specific characteristics of the application, such as the reflectance inside the application or the dispersion parameters of the light-emitting surface.

**Please note:** The resulting luminance applies to one of the two light-emitting surfaces of a double-sided light box.

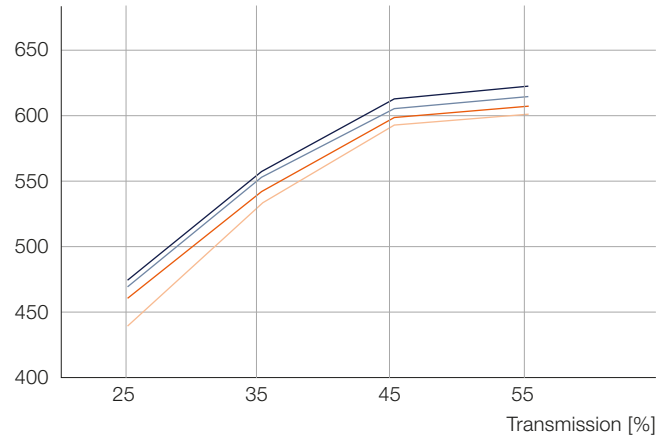
#### Approx. 5.75 LED modules/m<sup>2</sup>

Return depth: ■ 250 mm ■ 300 mm ■ 350 mm ■ 400 mm  
Luminance [cd/m<sup>2</sup>]\*



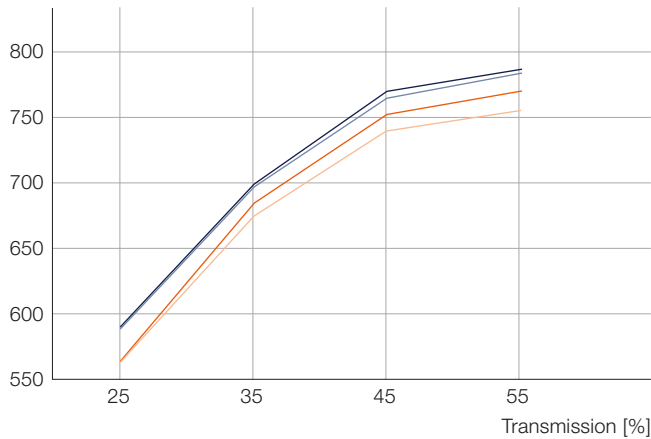
#### Approx. 7.75 LED modules/m<sup>2</sup>

Return depth: ■ 250 mm ■ 300 mm ■ 350 mm ■ 400 mm  
Luminance [cd/m<sup>2</sup>]\*



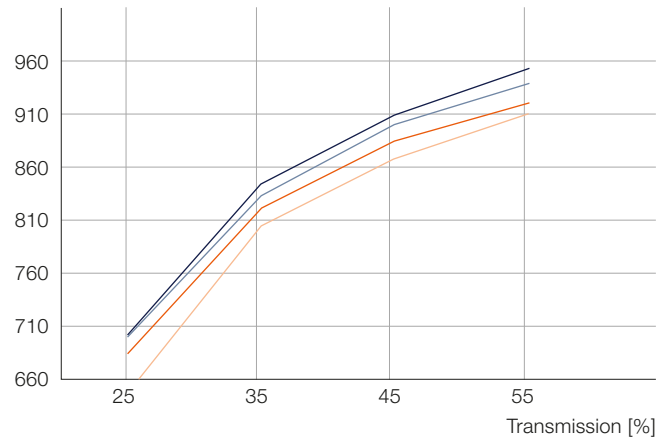
#### Approx. 9.5 LED modules/m<sup>2</sup>

Return depth: ■ 250 mm ■ 300 mm ■ 350 mm ■ 400 mm  
Luminance [cd/m<sup>2</sup>]\*



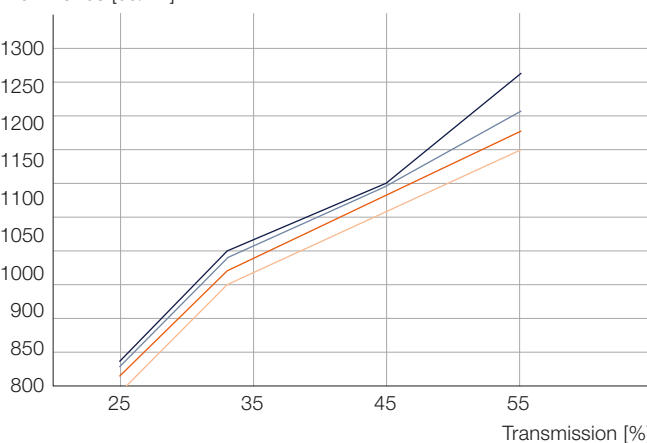
#### Approx. 11.5 LED modules/m<sup>2</sup>

Return depth: ■ 250 mm ■ 300 mm ■ 350 mm ■ 400 mm  
Luminance [cd/m<sup>2</sup>]\*



#### Approx. 14.5 LED modules/m<sup>2</sup>

Return depth: ■ 250 mm ■ 300 mm ■ 350 mm ■ 400 mm  
Luminance [cd/m<sup>2</sup>]\*



\* At minimum return with even illumination

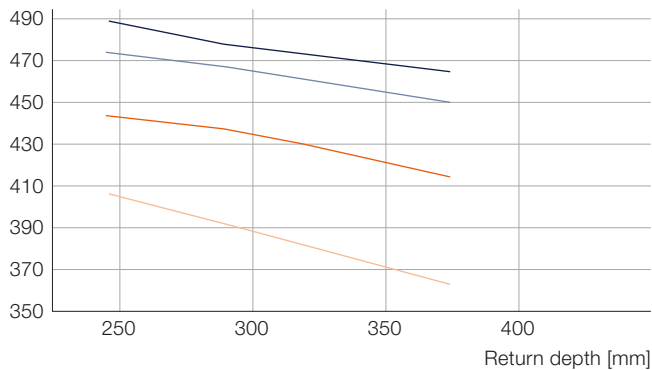
### 3.3 Luminance as a function of return depth: BackLED DS Plus G15

The graphs below show the dependency between the return depth and the resulting luminance related to different transmission values. Each graph refers to a different density of the LED modules (number of LED modules per m<sup>2</sup>).

#### Approx. 5.5 LED modules/m<sup>2</sup>

Transmission: ■ 55 % ■ 45 % ■ 35 % ■ 25 %

Luminance [cd/m<sup>2</sup>]



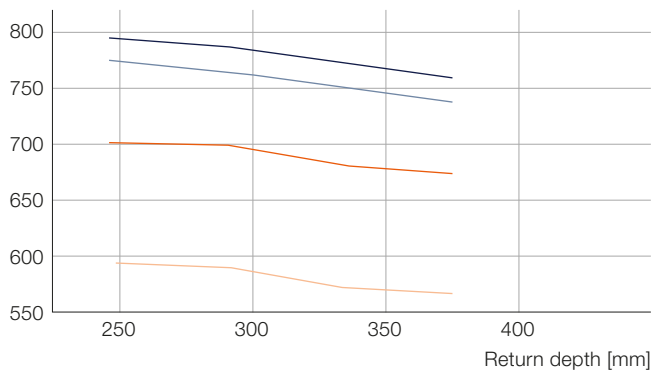
Constant distance between modules: 400 mm

Constant distance between parallel module strings: **400 mm**

#### Approx. 9.5 LED modules/m<sup>2</sup>

Transmission: ■ 55 % ■ 45 % ■ 35 % ■ 25 %

Luminance [cd/m<sup>2</sup>]



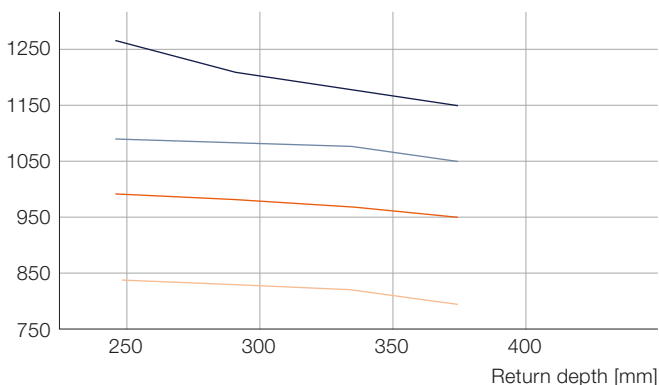
Constant distance between modules: 325 mm

Constant distance between parallel module strings: **325 mm**

#### Approx. 14.5 LED modules/m<sup>2</sup>

Transmission: ■ 55 % ■ 45 % ■ 35 % ■ 25 %

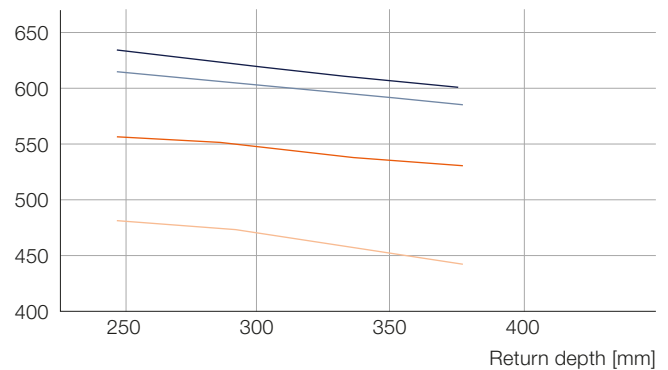
Luminance [cd/m<sup>2</sup>]



#### Approx. 7.5 LED modules/m<sup>2</sup>

Transmission: ■ 55 % ■ 45 % ■ 35 % ■ 25 %

Luminance [cd/m<sup>2</sup>]



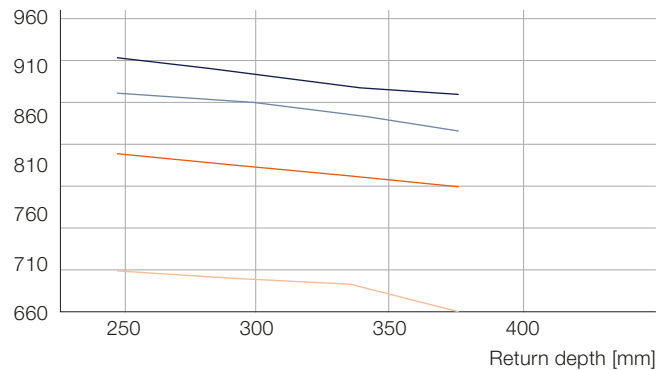
Constant distance between modules: 325 mm

Constant distance between parallel module strings: **400 mm**

#### Approx. 11.5 LED modules/m<sup>2</sup>

Transmission: ■ 55 % ■ 45 % ■ 35 % ■ 25 %

Luminance [cd/m<sup>2</sup>]



Constant distance between modules: 265 mm

Constant distance between parallel module strings: **325 mm**

Constant distance between modules: 265 mm (fully stretched)

Constant distance between parallel module strings: **265 mm**

#### Definition:

Return depth: Distance between LED modules (mounting surface) and light-emitting surface (e.g. acrylic sheet, fabric)

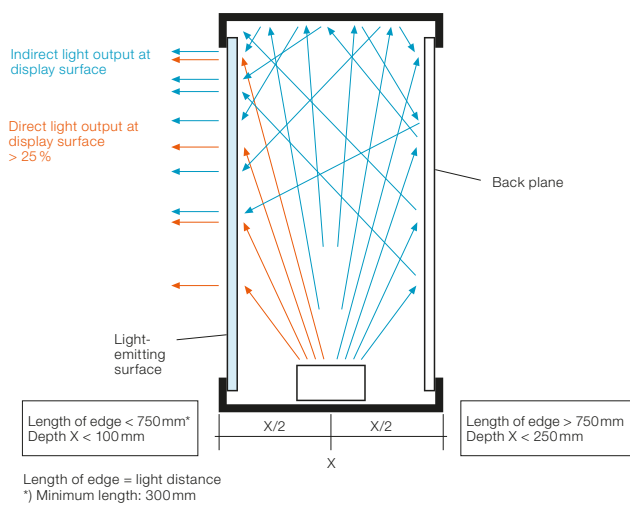
**Please note:** The values above are only an approximation! The luminance, uniformity and power consumption can deviate because of different application parameters, e.g. reflection of the inner surface, parameters of the light-emitting surface etc. Prior to installation, all applications should be checked for acceptable illumination in terms of color appearance, uniformity, luminance level and functionality.

# 4 Application overviews for BoxLED® Plus G15

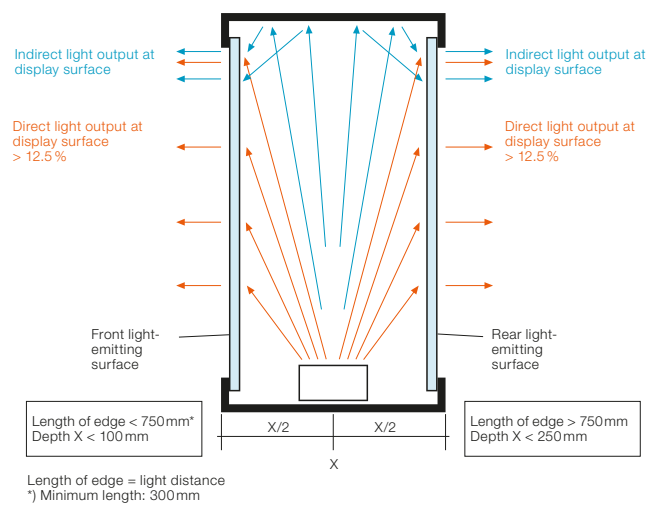
## 4.1 Recommended dimensions for light boxes

BoxLED® Plus G15 modules provide uniform illumination thanks to a beneficial mix of direct and indirect light.

### Direct and indirect light output of a single-sided light box



### Direct and indirect light output of a double-sided light box

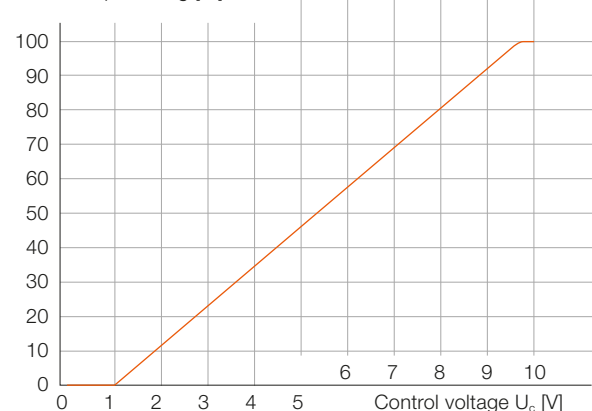


For the illumination of light boxes, we recommend that the BoxLED® Plus G15 modules be arranged in the center of the light box frame to achieve a uniform distribution of light. Placing the LED module closer to the light-emitting surface increases the direct light output at this surface.

## 4.2 Power output characteristic curve of the dimmable 1...10V LED drivers

The  $\Phi$ - $U_c$  characteristic curve in the diagram on the right shows a general definition of the power output depending on the control voltage of an OT DIM, OT 60/220-240/12 DIM P, OT 80/220-240/24 DIM P, OT 120/220-240/24 DIM P or OT 240/220-240 24 DIM P.

Power output rating [%]



Operation without applied control voltage (shorted) → 0 % power output  
 Operation without applied control voltage (floating) → 100 % power output

# 5 Thermal properties

## 5.1 Casing temperature at the $T_c$ point

The casing temperature is the temperature at a defined point on the LED casing, the  $T_c$  point. The maximum  $T_c$  temperature is the highest permitted temperature that may occur at the  $T_c$  point under the planned ambient and operating conditions in the thermally steady state.

If the maximum permitted  $T_c$  temperature is exceeded, the LED module may go into a state in which the load limits on the module (LED, casing, chip, encapsulation materials) are reached. A thermal link between the modules and the mounting surface is not absolutely essential.

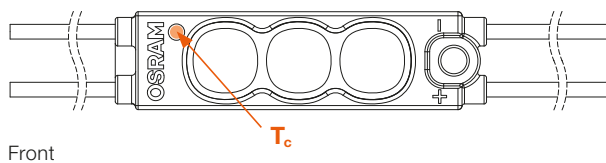
## 5.2 Measuring the $T_c$ temperature

The indicated lifetime can only be achieved if the permitted operating temperatures at the  $T_c$  point are maintained. After the LED modules have been installed in a light box, the  $T_c$  temperature must be measured under the planned ambient and operating conditions in the thermally steady state. To do this, attach a temperature sensor to the  $T_c$  point with suitable adhesive (cyanoacrylate-free).

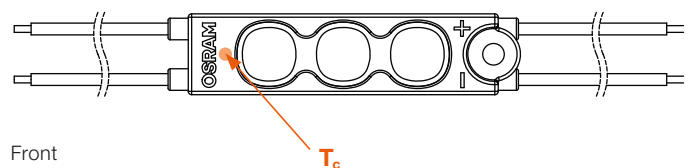


### 5.2.1 Position of the $T_c$ point

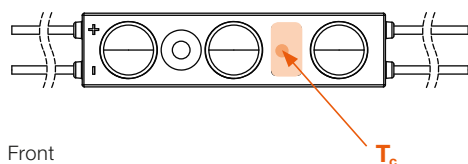
#### BackLED S Plus G15



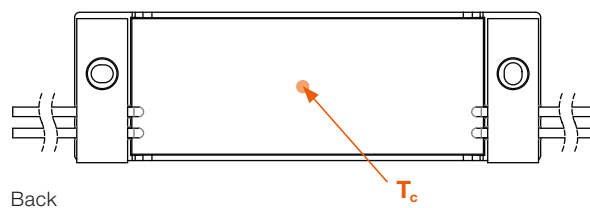
#### BackLED M Plus G15



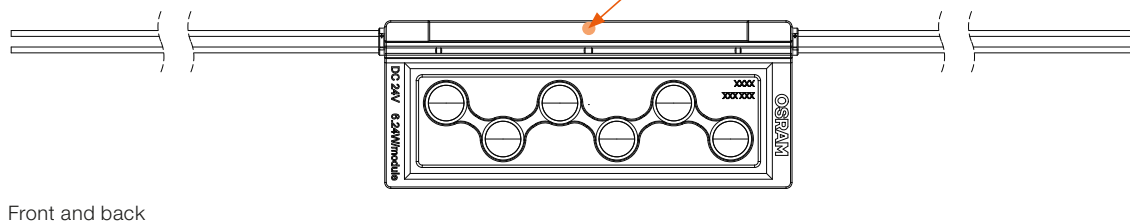
#### BackLED L Plus G15



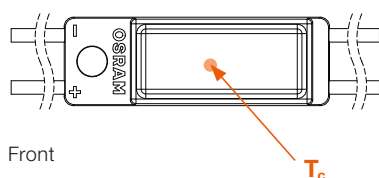
#### BackLED XL Plus G15



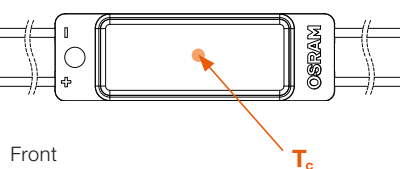
#### BackLED DS Plus G15



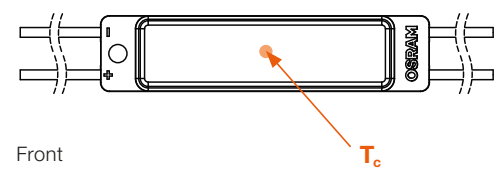
#### BackLED XS Basic G15



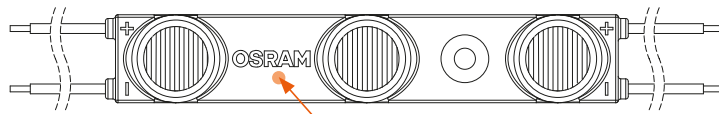
#### BackLED M Basic G15



#### BackLED L Basic G15



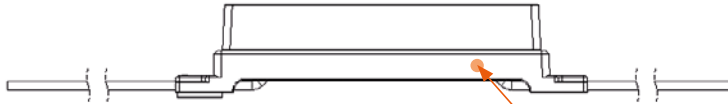
### BoxLED® XS Plus G15



Front

$T_c$

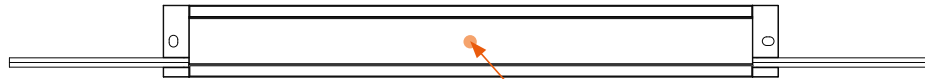
### BoxLED® eco M Plus G3



Side view

$T_c$

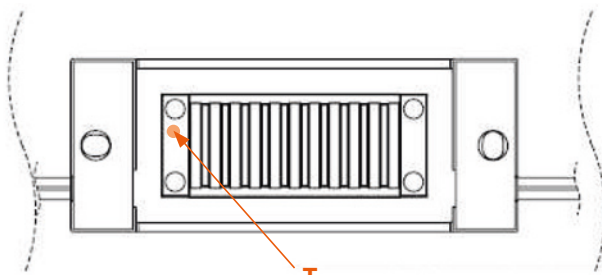
### BoxLED® L Plus G15



Back

$T_c$

### BoxLED® Side Plus



Back

$T_c$

## 5.2.2 Permitted $T_c$ temperatures

	Operating temperature at the $T_c$ point* [°C]
<b>BackLED S Plus G15</b>	-25 to 65
<b>BackLED M Plus G15</b>	-25 to 70 (white) -25 to 75 (red)
<b>BackLED L Plus G15</b>	-25 to 75
<b>BackLED XL Plus G15</b>	-25 to 85
<b>BackLED DS Plus G15</b>	-25 to 80
<b>BackLED XS Basic G15</b>	-25 to 70
<b>BackLED M Basic G15</b>	-25 to 65
<b>BackLED L Basic G15</b>	-25 to 70
<b>BoxLED XS Plus G15</b>	-25 to 80
<b>BoxLED eco M Plus G3</b>	-25 to 70
<b>BoxLED L Plus G15</b>	-25 to 80
<b>BoxLED Side Plus</b>	-25 to 85

\* If the maximum temperature limits are exceeded, the lifetime of the module will be greatly reduced or the module may be destroyed. The temperature of the LED module at the  $T_c$  point should be measured in the thermally steady state by means of a temperature sensor or temperature-sensitive sticker in accordance with EN 60598-1. For the precise position of the  $T_c$  point, see chapter 5.2.1.



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