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Technical application guide
Basic Linear G2

OSRAM

Contents

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1 Introduction

1.1 Basic Linear G2

Best offer in terms of cost efficiency, no compromise in quality of light

For a very wide range of lighting applications that are characterized by high cost pressure, Basic Linear G2 LED modules have proven to be the right choice. They are primarily used in luminaires that have to achieve a high lumens/EUR ratio.

Basic lighting needs good light

Basic Linear G2 LED modules are mainly used in solutions for industrial and car park lighting. Thanks to their small LED pitch, they can, for example, provide homogeneous light combined with the high light quality needed in industrial areas such as storage areas and warehouses or other general indoor applications.

Basic Linear G2 LED modules easily fit any car park lighting solution in shopping centers, office buildings or airports, where the requirements of basic lighting need to be fulfilled.

One product for various luminaire types

As Basic Linear G2 LED modules can be underdriven/overdriven by changing the current, they are suitable for different luminaire segments. For example, the same Basic Linear G2 LED module can be used for 1200-mm luminaires with high/low luminous flux as well as for 1500-mm luminaires with high/low luminous flux.

On the one hand, Basic Linear G2 LED modules are perfectly matched to cost-efficient linear on/off LED drivers such as OPTOTRONIC® OT FIT or ELEMENT drivers. On the other hand, they can also be easily used with DALI, programmable or non-programmable LED drivers.

1.2 System solution

We offer you the optimal combination of LED module and LED driver. By combining OPTOTRONIC® Linear LED drivers with Basic Linear G2 LED modules, you always get the best possible system solution, which is perfectly complemented by useful accessories and modern LMS components for efficient and multifunctional light management.

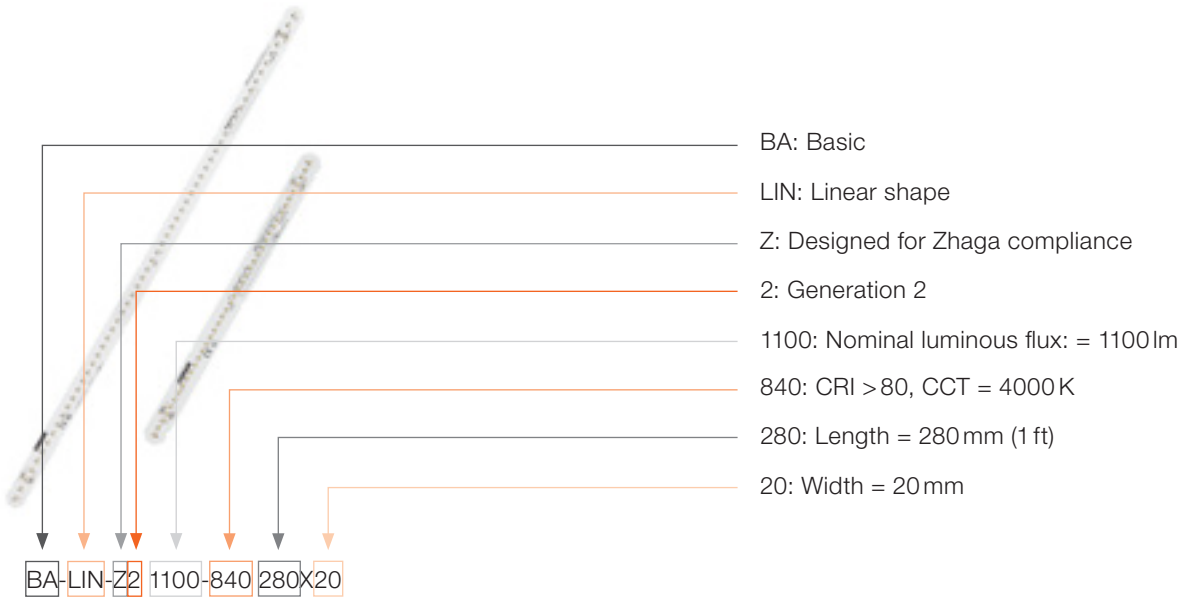
1.3 Features and benefits

- Efficiency: Up to 152 lm/W
- Initial color consistency ≤ 3 SDCM
- CCT: 3000 K and 4000 K
- CRI: > 80
- Same LED module for SELV or non-insolated luminaire design
- Average lifetime (L80B50): 50000 h at t_c = 55 °C
- Geometry according to Zhaga book 7 L28W2, L56W2

1.4 LED module portfolio and nomenclature

The Basic Linear G2 portfolio is available in three different lengths of 280 mm, 560 mm and 1120 mm, a width of 20 mm as well as a wide range of different lumen packages from 1100 lm to 4400 lm provided by one single module. It is available in two different color temperatures of 3000 K and 4000 K. The color rendering index of all Basic Linear G2 LED module types is >80.

The LED module nomenclature is explained below for the example of an LED module with the following characteristics: CCT = 4000 K, CRI >80, nominal luminous flux = 1100 lm, length = 280 mm, width = 20 mm.



1.5 Electrical and optical data at typical conditions (for a t_p temperature of 55 °C)

Nominal current (250 mA)*

Product name	Flux [lm]*	CCT [K]	CRI	SDCM	Voltage [V]	I_f [mA]	Power [W]*	Efficacy [lm/W]
BA-LIN-Z2 1100-830 280X20	1064	3000	>80	3	29.7	250	7.4	144
BA-LIN-Z2 1100-840 280X20	1119	4000	>80	3	29.7	250	7.4	151
BA-LIN-Z2 1550-830 560X20	1495	3000	>80	3	41.5	250	10.4	144
BA-LIN-Z2 1550-840 560X20	1569	4000	>80	3	41.5	250	10.4	151
BA-LIN-Z2 2200-830 560X20	2129	3000	>80	3	59.4	250	14.8	144
BA-LIN-Z2 2200-840 560X20	2243	4000	>80	3	59.4	250	14.8	152
BA-LIN-Z2 4400-830 1120X20	4257	3000	>80	3	118.7	250	29.7	143
BA-LIN-Z2 4400-840 1120X20	4485	4000	>80	3	118.7	250	29.7	151

300 mA*

Product name	Flux [lm]*	CCT [K]	CRI	SDCM	Voltage [V]	I_f [mA]	Power [W]*	Efficacy [lm/W]
BA-LIN-Z2 1100-830 280X20	1210	3000	>80	3	30.3	300	9.1	133
BA-LIN-Z2 1100-840 280X20	1280	4000	>80	3	30.3	300	9.1	141
BA-LIN-Z2 1550-830 560X20	1685	3000	>80	3	42.4	300	12.7	133
BA-LIN-Z2 1550-840 560X20	1800	4000	>80	3	42.4	300	12.7	141
BA-LIN-Z2 2200-830 560X20	2400	3000	>80	3	60.5	300	18.2	133
BA-LIN-Z2 2200-840 560X20	2560	4000	>80	3	60.5	300	18.2	141
BA-LIN-Z2 4400-830 1120X20	4815	3000	>80	3	121	300	36.3	133
BA-LIN-Z2 4400-840 1120X20	5120	4000	>80	3	121	300	36.3	141

350 mA*

Product name	Flux [lm]*	CCT [K]	CRI	SDCM	Voltage [V]	I_f [mA]	Power [W]*	Efficacy [lm/W]
BA-LIN-Z2 1100-830 280X20	1385	3000	>80	3	30.8	350	10.8	128
BA-LIN-Z2 1100-840 280X20	1465	4000	>80	3	30.8	350	10.8	136
BA-LIN-Z2 1550-830 560X20	1930	3000	>80	3	43.2	350	15.1	128
BA-LIN-Z2 1550-840 560X20	2065	4000	>80	3	43.2	350	15.1	136
BA-LIN-Z2 2200-830 560X20	2750	3000	>80	3	61.6	350	21.6	128
BA-LIN-Z2 2200-840 560X20	2930	4000	>80	3	61.6	350	21.6	136
BA-LIN-Z2 4400-830 1120X20	5510	3000	>80	3	123.3	350	43.2	128
BA-LIN-Z2 4400-840 1120X20	5860	4000	>80	3	123.3	350	43.2	136

Typical values valid for t_p = 55 °C
Energy Efficiency Class according to 2012/874/EC: A++

Due to the special conditions of the manufacturing processes of LEDs, the typical data of technical parameters can only reflect statistical figures and do not necessarily correspond to the actual parameters of each single product, which could differ from the typical data.

* Tolerance for optical and electrical data: ± 10 %

Maximum current (400 mA)*

Product name	Flux [lm]*	CCT [K]	CRI	SDCM	Voltage [V]	I_f [mA]	Power [W]*	Efficacy [lm/W]
BA-LIN-Z2 1100-830 280X20	1530	3000	>80	3	31.4	400	12.6	121
BA-LIN-Z2 1100-840 280X20	1615	4000	>80	3	31.4	400	12.6	129
BA-LIN-Z2 1550-830 560X20	2130	3000	>80	3	43.9	400	17.6	121
BA-LIN-Z2 1550-840 560X20	2275	4000	>80	3	43.9	400	17.6	129
BA-LIN-Z2 2200-830 560X20	3045	3000	>80	3	62.8	400	25.1	121
BA-LIN-Z2 2200-840 560X20	3230	4000	>80	3	62.8	400	25.1	129
BA-LIN-Z2 4400-830 1120X20	6085	3000	>80	3	125.5	400	50.2	121
BA-LIN-Z2 4400-840 1120X20	6465	4000	>80	3	125.5	400	50.2	129

Typical values valid for t_p = 55 °C
Energy Efficiency Class according to 2012/874/EC: A++

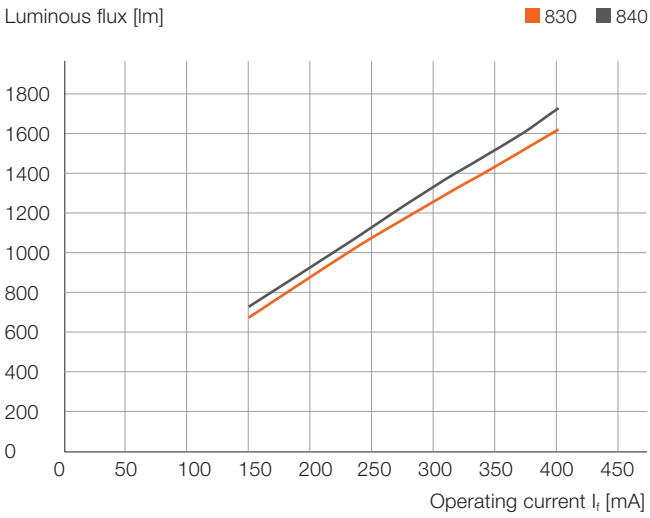
Due to the special conditions of the manufacturing processes of LEDs, the typical data of technical parameters can only reflect statistical figures and do not necessarily correspond to the actual parameters of each single product, which could differ from the typical data.

* Tolerance for optical and electrical data: ± 10 %

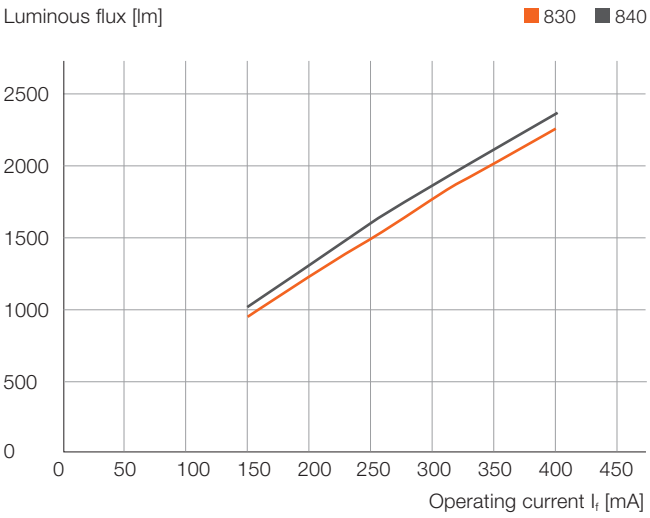
1.6 Luminous flux as a function of forward current

The luminous flux of the LED modules depends on the applied forward current. It is possible, however, to vary between the nominal and absolute maximum current values for each module type and also below the nominal current, e.g. to exactly set a requested value for the luminous flux. The diagrams below show the luminous flux at nominal conditions (t_p = 55 °C) for different currents.

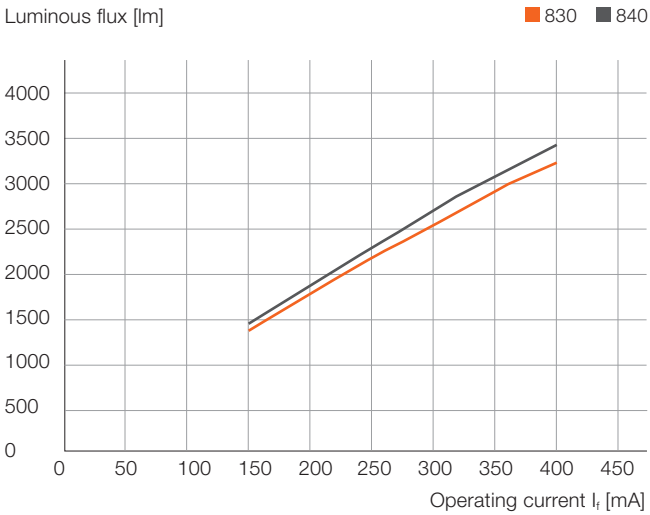
BA-LIN-Z2 1100-8xx 280X20



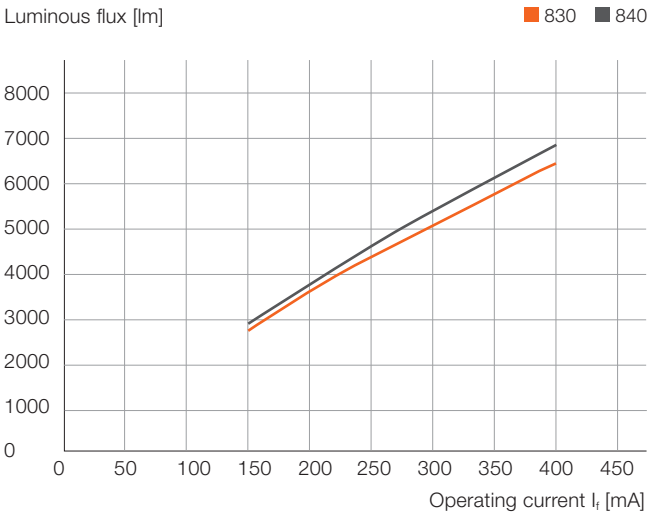
BA-LIN-Z2 1550-8xx 560X20



BA-LIN-Z2 2200-8xx 560X20



BA-LIN-Z2 4400-8xx 1120X20



By choosing the requested luminous flux on the y-axis of the diagram, you can derive the needed forward current that has to be applied to the LED module on the x-axis. This also works the other way around: For a set current, you can read the corresponding luminous flux on the y-axis.

1.7 Luminous flux and efficiency as functions of t_c point temperature

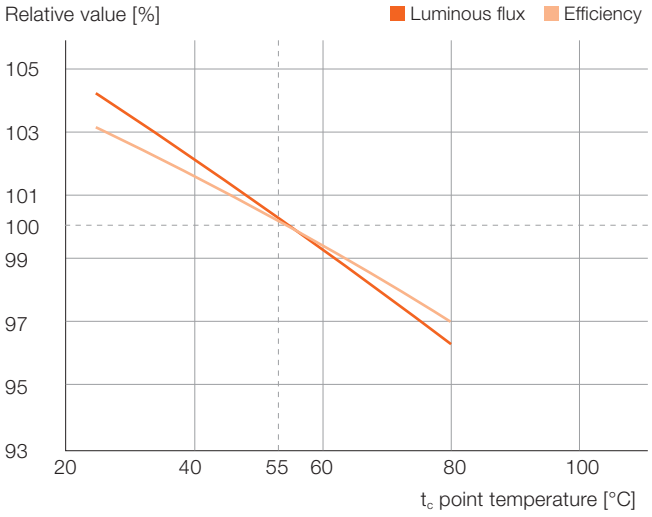
All tables and diagrams shown up to now were measured or calculated for a t_c point temperature of 55 °C, the nominal temperature condition of the Basic Linear G2 LED modules. It is of course realistic and likely that the t_c point temperature in a given luminaire differs from the nominal conditions and that this has an impact on the luminous flux and efficiency.

If the t_c point temperature on the LED module is lower than the nominal temperature of 55 °C, the relative luminous flux and relative efficiency are increased.

If the t_c point temperature on the LED module is higher than the nominal temperature of 55 °C, the relative luminous flux and relative efficiency are decreased.

The diagram below shows the correlation between the t_c point temperature and relative luminous flux/efficiency. Since it shows only relative values, the diagram gives an approximation that can be used for all the different module types (e.g. different color temperatures, different module lengths).*

Luminous flux and efficiency as functions of t_c point temperature



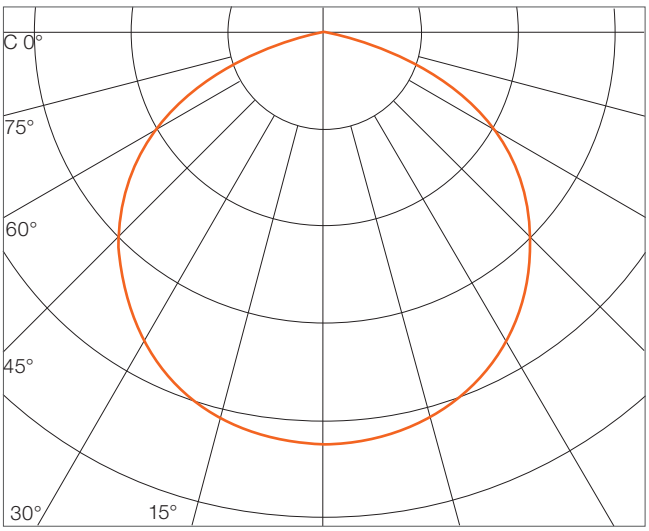
* Of course, all tolerances given in the datasheet of the Basic Linear G2 LED modules are still valid.

2 Optical considerations

2.1 Light distribution

The light distribution of Basic Linear G2 has a Lambertian shape with a beam angle of 120° FWHM (full width at half maximum).

EULUMDAT files can be found on our website at www.inventronics-light.com.



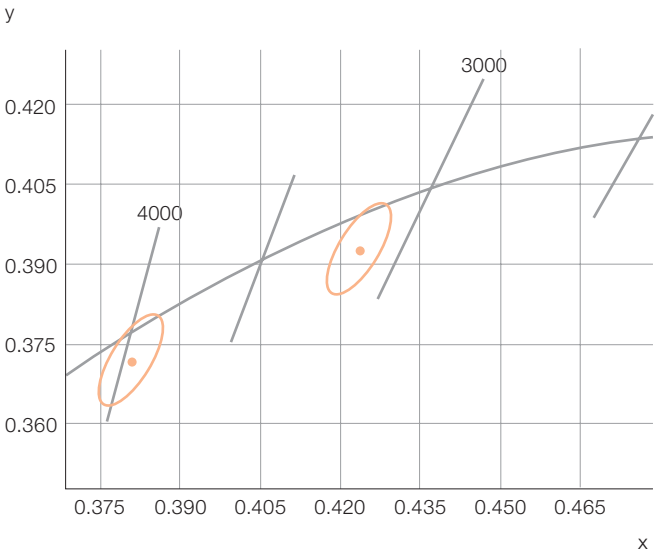
2.2 Color temperature and coordinates

Basic Linear G2 is available with color temperatures of 3000 K and 4000 K at CRI > 80. The color coordinate windows within the CIE 1931 color space are given below.

	3000 K	4000 K
Cx	0.4271	0.3759
Cy	0.3958	0.3729

Within each available color temperature, the Basic Linear G2 series provides a Standard Deviation of Color Matching (SDCM) of 3. SDCM is measured in “MacAdam ellipses” and determines the light color of LED lights with similar color temperature. A low number of MacAdam ellipses means a better color quality.

Threshold values within the CIE 1931 color space

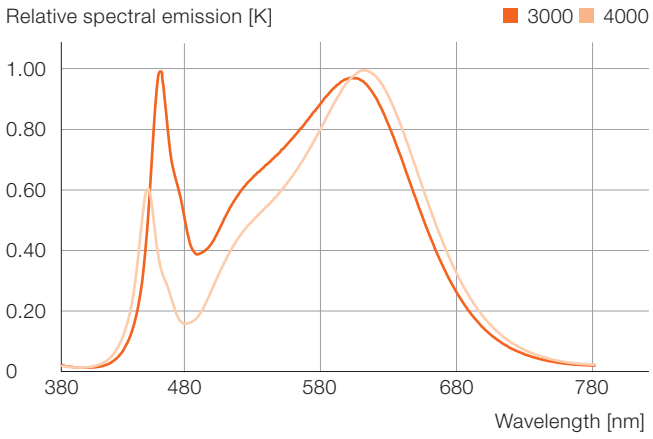


* All values in this chapter are general values. Values for specific modules may vary from these values. Please refer to the corresponding datasheet.

2.3 Spectral distribution

The following diagram shows the typical spectral distribution of Basic Linear G2 LED modules for different available color temperatures.

Spectral distribution



Values measured at t_p = 55 °C

2.4 Color rendering

Basic Linear G2 LED modules provide a color rendering index (CRI) of > 80. The tables below show the individual R_a values from R1 to R14 for the available color temperatures (measured at nominal current, t_p = 55 °C).

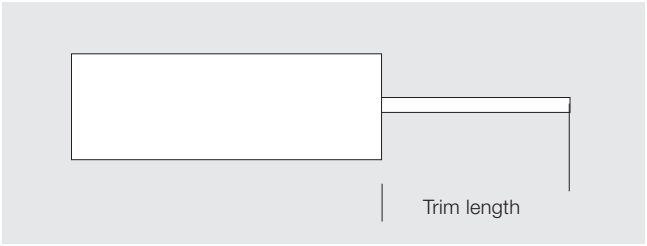
R_a values for Basic Linear G2

	Dusky pink	Mustard yellow	Yellowish green	Light green	Turquois	Azure	Aster violet	Lilac violet	Red, saturated	Yellow, saturated	Green, saturated	Blue, saturated	Pink, skin color	Leaf green	General CRI
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R_a
CCT = 3000 K	83	91	96	84	83	89	85	64	17	78	84	76	85	98	84
CCT = 4000 K	84	93	96	82	84	90	86	66	16	83	81	64	87	99	85

3 Electrical considerations

3.1 Wiring information

The connector used on the Basic Linear G2 LED modules (see picture above) can handle solid wires and fine-stranded wires with cross-sections from 0.14 to 0.75 mm² (AWG 26–18). The use of solid wires is recommended. The maximum insulation diameter is 2.3 mm.



The stripped length is recommended to be 5.0 ± 0.5 mm. Please insert wires in 0° orientation into the PCB.

3.2 Disconnecting the wire from the connector

The connector on the Basic Linear G2 LED module has an easy and simple “poke-in” and release mechanism. Solid wires can simply be plugged into the connector. If fine-stranded wires are used, it is recommended to use the release button on the side of the connector also for easier insertion. The wires/cables can be removed by pressing the release button on the side of the connector and pulling the wires/cables out.

The pictures below show how to disconnect a wire from the connector.

3.3 Electrostatic discharge (ESD)

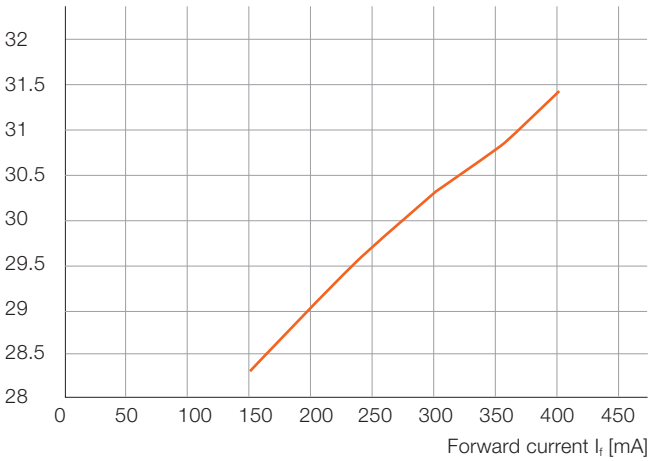
Basic Linear G2 LED modules fulfill the requirement of the immunity standard IEC/EN 61547. Please note that an electrostatic discharge of more than 2 kV HBM can cause damage, ranging from performance degradation to complete device failure.

We recommend to handle and store all Basic Linear G2 LED modules using appropriate ESD protection methods.

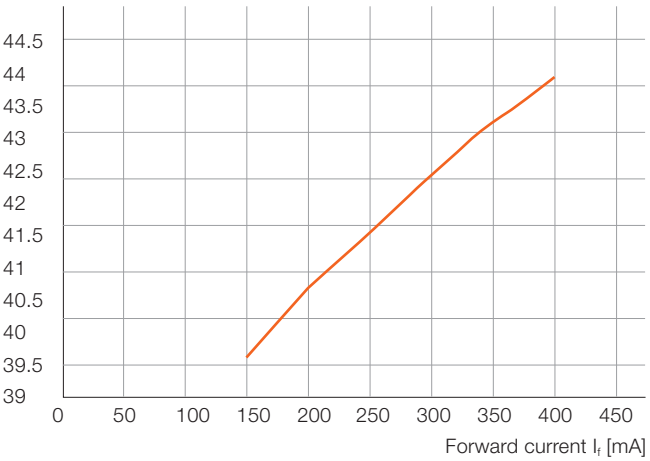
3.4 Forward voltage as a function of forward current*

The diagrams below show the relative dependence of the forward voltage (V_f) on the forward current (I_f) for the different Basic Linear G2 LED modules. They show only the area that is of interest for lighting applications, which is in first approximation linear.

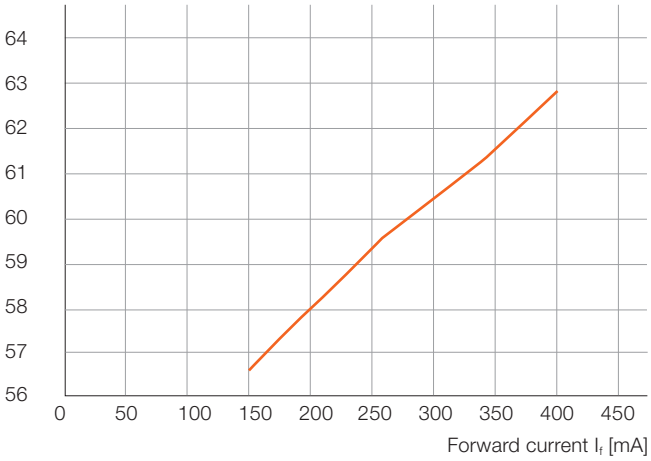
BA-LIN-Z2 1100-8xx 280X20



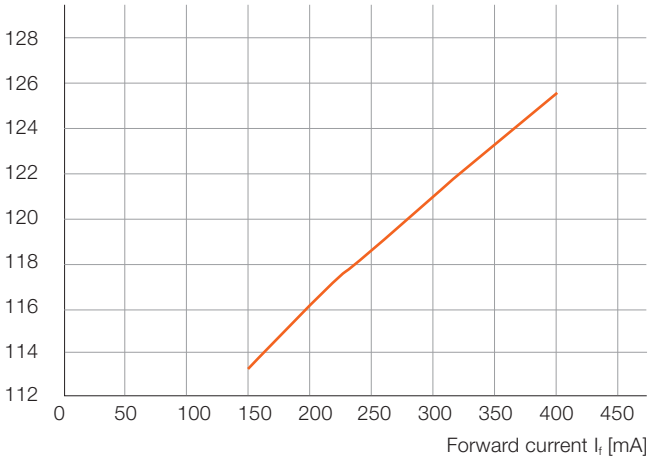
BA-LIN-Z2 1550-8xx 560X20



BA-LIN-Z2 2200-8xx 560X20



BA-LIN-Z2 4400-8xx 1120X20



* All tolerances given in the datasheet of the Basic Linear G2 LED modules are still valid.

4 LED systems: Basic Linear G2 and OPTOTRONIC® LED drivers

4.1 LED module/driver combinations

Basic Linear G2 LED modules are designed to be used together with OSRAM OPTOTRONIC® LED drivers – both in the SELV ($V_f < 54$ V) and non-SELV ($V_f > 54$ V) range. A single LED module (BA-LIN-Z2 1100-8xx 280X20, BA-LIN-Z2 1550-8xx 560X20) is within the SELV range. By connecting more than one module in series, the voltage reaches the range of the OPTOTRONIC® non-SELV LED drivers.

Series and parallel connection

Basic Linear G2 LED modules can be connected either in parallel or in series, as shown in the pictures below.

Basic Linear G2 LED modules connected in parallel to an LED driver

If LED modules are connected in parallel, the “+” of one LED module is connected to the “+” of the following LED module and the “-” of one LED module is connected to the “-” of the following LED module. The last LED module in the chain is connected to the LED driver (here again, the “+” of the LED module is connected with the “+” of the LED driver and the “-” of the LED module with the “-” of the LED driver.

A schematic of four LED modules connected in parallel to an LED driver is shown below, together with a picture of two modules connected in parallel.

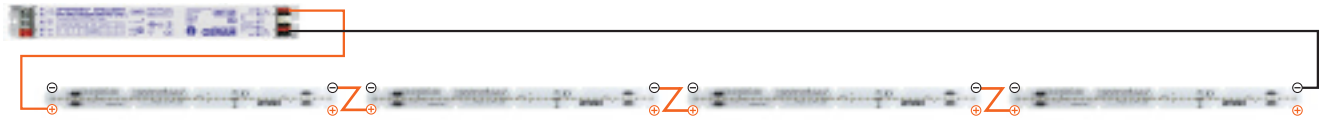
Basic Linear G2 LED modules connected in parallel to an OPTOTRONIC® LED driver

Example: Parallel connection of two Basic Linear G2 LED modules

Basic Linear G2 LED modules connected in series to an LED driver

LED modules can also be connected in series to LED drivers. A schematic of four modules connected in series is shown below.

Basic Linear G2 LED modules connected in series to an OPTOTRONIC® LED driver



Example: Series connection of two Basic Linear G2 LED modules

Basic Linear G2 LED modules connected in series to an LED driver – with one rotated module
If every second module in the chain connected in series is rotated by 180°, the wiring can be done with one straight wire (in this case, no “S” shape is needed). This can reduce the wiring effort and simplify module installation.

Example: Simplified series connection of two Basic Linear G2 LED modules

Electrically, parallel and/or series connections of Basic Linear G2 LED modules have the following impacts on the electrical parameters:

When connecting two modules in parallel:
V_f (two modules) = V_f (single module)
I_f (two modules) = 2 x I_f (single module)

When connecting two modules in series:
V_f (two modules) = 2 x V_f (single module)
I_f (two modules) = I_f (single module)

When connecting N modules in parallel:
V_f (N modules) = V_f (single module)
I_f (N modules) = N x I_f (single module)

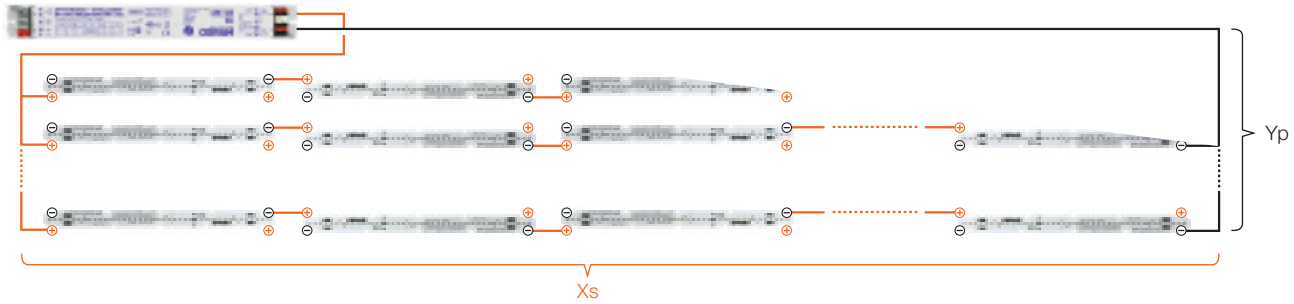
When connecting N modules in series:
V_f (N modules) = N x V_f (single module)
I_f (N modules) = I_f (single module)

OSRAM OPTOTRONIC® SELV LED drivers cover a voltage range up to 54 V. This means that for using SELV LED drivers, a parallel-only wiring of the Basic Linear G2 LED modules to the LED driver is necessary. When using LED drivers from the non-SELV/non-isolated portfolio (voltage range from 54 V to 150 V…240 V), it is possible to connect the LED modules in series to the LED driver or to use a combination of parallel and series connection.

Please note:
If the LED modules are connected in series to the LED driver, it is possible to combine 280-mm LED modules and 560-mm LED modules with the same LED pitch (i.e. 1100-lm LED modules with 2200-lm LED modules). The main benefit is that less components have to be connected and assembled. (There can also be a price advantage.) The electrical parameters remain unchanged.

Definition of the XsYp notation:
The tables in the datasheets and in section 4.2 (see here) use the “XsYp” notation with “X” representing the number of LED modules that are connected in series and “Y” representing the number of LED modules connected in parallel.

XsYp notation



The tables in the datasheets do not only provide information about how many LED modules can be connected to an OPTOTRONIC® constant-current LED driver, but they also show the exact wiring schematics.

4.2 System combination tables

In different applications, Basic Linear G2 LED modules can be used in a wide range of LED module/driver combinations. The most important (but not all possible) combinations are shown in the following tables.

Operation with OPTOTRONIC® SELV LED drivers

OTi DALI (wide-current-window driver – SELV)
Dimmable

Basic Linear G2 LED modules are designed to be operated with OTi DALI LED drivers in parallel connection. Current setting is carried out via resistor coding (LEDset) for OTi LED drivers or via Tuner4TRONIC® software and DALI magic for OTi DALI LED drivers.

OT FIT CS (triple-current driver – SELV)
Non-dimmable

Basic Linear G2 LED modules are designed to be operated with OT FIT LED drivers in parallel connection. Current setting is carried out via cable bridge on the driver's primary side.

System combinations with OTi DALI drivers (wide-current-window driver – SELV) and OT FIT CS drivers (triple-current LED drivers – SELV)*

		Dimmable			Non-dimmable
		OTi DALI 50/220-240/1A4 LT2 L	**OTi DALI 80/220-240/1A6 LT2 L**	**OTi DALI 80/220-240/2A1 LT2 L**	**OT FIT 75/220-240/1400 CS L G2**
	Current	0.6 A–1.4 A	0.6 A–1.55 A	1.0 A–2.1 A	1100/1200/1300/1400 mA
1100 lm (280 mm)	250 mA	3–5	5–6	5–8	–
	300 mA	3–4	4–5	4–7	4
	350 mA	2–4	3–4	3–6	4
1550 lm (560 mm)	250 mA	2–4	4–6	4–7	–
	300 mA	2–3	3–5	3–6	4
	350 mA	2–3	3–4	3–5	4
2200 lm(560 mm)	250 mA	–	–	–	–
	300 mA	–	–	–	–
	350 mA	–	–	–	–
4400 lm (1120 mm)	250 mA	–	–	–	–
	300 mA	–	–	–	–
	350 mA	–	–	–	–
		Parallel connection			

* These combinations are valid if the modules are driven with nominal current. If other currents are used, other combinations are possible.

Operation with OPTOTRONIC® non-SELV/ non-isolated LED drivers

OT FIT D/ELEMENT (single-current LED driver – non-SELV/non-isolated)

Basic Linear G2 LED modules are designed to be operated with OT FIT D drivers with single current output or with ELEMENT drivers with current selection via DIP switch.

System combinations with OT FIT D and ELEMENT drivers (non-dimmable LED drivers – non-SELV/non-isolated)*

		Non-dimmable							
		ELEMENT		OT FIT single current			OT FIT LEDset		
		ELEMENT 40/220-240/ 350 D CS L	ELEMENT 60/220-240/ 350 D CS L	OT FIT 50/ 220-240/ 250 D L	OT FIT 50/ 220-240/ 300 D L	OT FIT 50/ 220-240/ 350 D L	OT FIT 35/ 220-240/ 350 D LT2 L	OT FIT 75/ 220-240/ 550 D LT2 L	OT FIT 120/ 220-240/ 750 D LT2 L
	Current	250/300/350 mA	250/300/350 mA	250 mA	300 mA	350 mA	75–350 mA	125–550 mA	250–750 mA
1100 lm (280 mm)	250 mA	3–5	4–6	2–6	–	–	2–4	2–8 (2–6sYp)	2–14 (2–6sYp)
	300 mA	3	3–5	–	2–5	–	2–3	2–6	2–12 (2–6sYp)
	350 mA	3	3–5	–	–	2–4	2–3	2–6	2–10 (2–6sYp)
1550 lm (560 mm)	250 mA	2–3	3–4	2–4	–	–	2	2–6 (2–4sYp)	2–10 (2–4sYp)
	300 mA	2	3–4	–	2–3	–	2	2–4	2–8 (2–4sYp)
	350 mA	2	3	–	–	2–3	2	2–4	2–6 (2–4sYp)
2200 lm (560 mm)	250 mA	2	2–3	1–3	–	–	1–2	1–4 (1–3sYp)	1–6 (1–3sYp)
	300 mA	–	2	–	1–2	–	1	1–3	1–6 (1–3sYp)
	350 mA	–	2	–	–	1–2	1	1–3	1–4 (1–3sYp)
4400 lm (1120 mm)	250 mA	1	1	1	–	–	1	1–2 (1sYp)	1–3 (1sYp)
	300 mA	–	1	–	1	–	–	1	1–3 (1sYp)
	350 mA	–	1	–	–	1	–	1	1–2 (1sYp)
5500 lm (1120 + 280 mm)	250 mA	1	1	1	–	–		1	1–3
	300 mA	–	1	–	1	–		1	1–2
	350 mA	–	1	–	–	–		1	1–2
		Series and combined series-parallel connection							

* These combinations are valid if the modules are driven with nominal current. If other currents are used, other combinations are possible.

OTi DALI (wide-current-window LED driver – non-SELV/non-isolated)
Basic Linear G2 LED modules are designed to be operated with OTi and OTi DALI LED drivers in series or combined series-parallel connection. Current setting is carried out via resistor coding (LEDset) and for OTi DALI LED drivers also via Tuner4TRONIC® software and DALI magic.

System combinations with OTi (DALI) drivers (wide-current-window LED drivers – non-SELV/non-isolated)*

		Dimmable			
		OTi DALI 35/220-240/400 D LT2 L	**OTi DALI 60/220-240/550 D LT2 L**	**OTi DALI 90/220-240/700 D LT2 L**	**OTi DALI 90/220-240/1A0 LT2 L**
	Current	75–400 mA	120–550 mA	250–700 mA	250–1000 mA
1100 lm (280 mm)	250 mA	2–4	2–7 (2–7sYp)	2–10 (2–7sYp)	2–10 (2–7sYp)
	300 mA	2–3	2–6	2–9 (2–7sYp)	2–9 (2–7sYp)
	350 mA	2–3	2–5	2–7 (2–7sYp)	2–7 (2–7sYp)
1550 lm (560 mm)	250 mA	2–3	2–5 (2–5sYp)	2–8 (2–5sYp)	2–8 (2–5sYp)
	300 mA	2	2–4	2–6 (2–5sYp)	2–6 (2–5sYp)
	350 mA	2	2–3	2–5 (2–5sYp)	2–5 (2–5sYp)
2200 lm (560 mm)	250 mA	1–2	1–3 (1–3sYp)	1–5 (1–3sYp)	1–5 (1–3sYp)
	300 mA	1	1–3	1–4 (1–3sYp)	1–4 (1–3sYp)
	350 mA	1	1–2	1–3 (1–3sYp)	1–3 (1–3sYp)
4400 lm (1120 mm)	250 mA	1	1	1–2 (1sYp)	1–2 (1sYp)
	300 mA	–	1	1–2 (1sYp)	1–2 (1sYp)
	350 mA	–	1	1	1
5500 lm (1120 + 280 mm)	250 mA	–	1	1–2	1–2
	300 mA	–	1	1	1
	350 mA	–	1	1	1
		Series and combined series-parallel connection			

* These combinations are valid if the modules are driven with nominal current. If other currents are used, other combinations are possible.

5 Thermal considerations

At nominal operating conditions, with the Basic Linear G2 mounted onto or into a luminaire housing with heat exchange to the environment, no special additional heat sink is needed to avoid exceeding t_c max = 80 °C.

To avoid overheating, it is nevertheless strongly recommended to check the LED module temperature in any newly designed luminaires.

It should also be mentioned here that lower t_c point temperatures on the LED module increase the module's efficiency. Therefore, providing efficient cooling for the Basic Linear G2 LED modules increases the system efficiency of the luminaire/application.

5.1 Introduction and definitions

For any LED module, including the Basic Linear G2 family, different temperatures (t_p, t_c, t_c max etc.) are mentioned in the datasheet. They are sometimes confused, therefore a short overview should be given at the beginning of this chapter:

- t_p is the performance temperature of the module. That means that all the tables, diagrams and numbers in the datasheet (and in this technical application guide) refer to the performance temperature t_p (if not mentioned otherwise).
- t_c is the critical module temperature of the LED module. Up to this temperature, one special feature can be guaranteed (e.g. the efficiency of the LED module at nominal current is higher than 140 lm/W up to a temperature of t_c = 55 °C).
- t_c max is the absolute maximum temperature up to which the operation of the LED module is recommended.

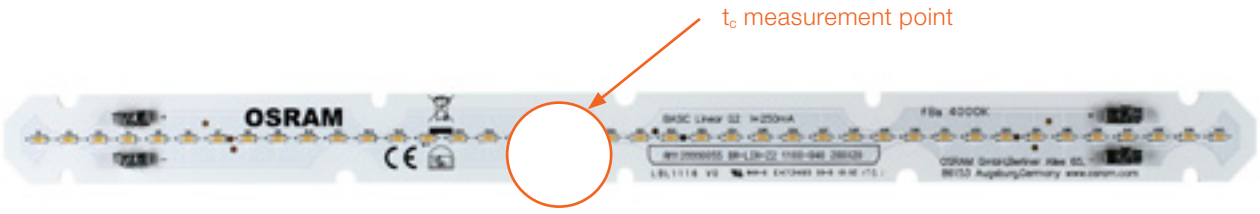
All temperatures mentioned above are measured at the same point on the LED module, which is (mostly for historical reasons) called the "t_c point" of the LED module. Its position on the Basic Linear G2 LED modules is shown below.

5.2 t_c location and measurement

Proper thermal design of an LED luminaire is critical for achieving best performance and ensuring long lifetime of all components. To achieve a lifetime of 50000 hours (L80B50), the sufficient heat exchange and thermal conduction between the LED modules and the luminaire housing has to be verified by measuring the temperature at the t_c point.

The maximum temperature reached at the t_c point must not exceed 80 °C. This reference point for Basic Linear G2 is shown in the image below for the 1100-lm/280-mm LED module type (for the other LED module types, the position is similar).

Position of the t_c measurement point on Basic Linear G2 LED modules



The easiest way to measure the temperature at the t_c point is by using a thermocouple. It is recommended to use a thermocouple that can be glued onto the LED module. Make sure that the thermocouple is fixed with direct contact to the t_c point.

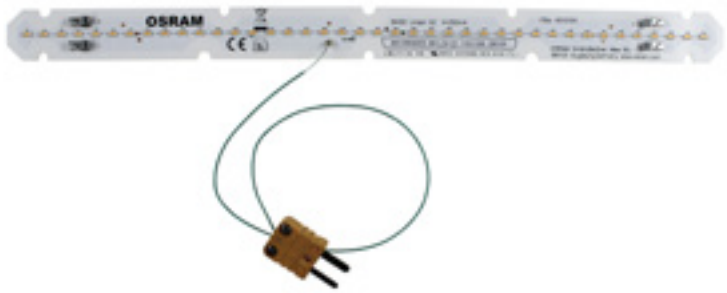
Examples of suitable thermocouples

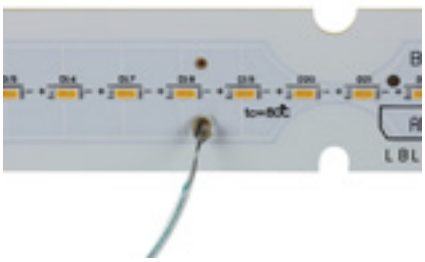
K-type thermocouple with miniature connector

Different thermocouples

Illustration	Description	Temperature range [°C]
	PVC-insulated thermocouple	-10 … +105
	PFA-insulated thermocouple	-75 … +260
	Sprung thermocouple	-75 … +260

Thermocouple mounted onto a Basic Linear G2 LED module

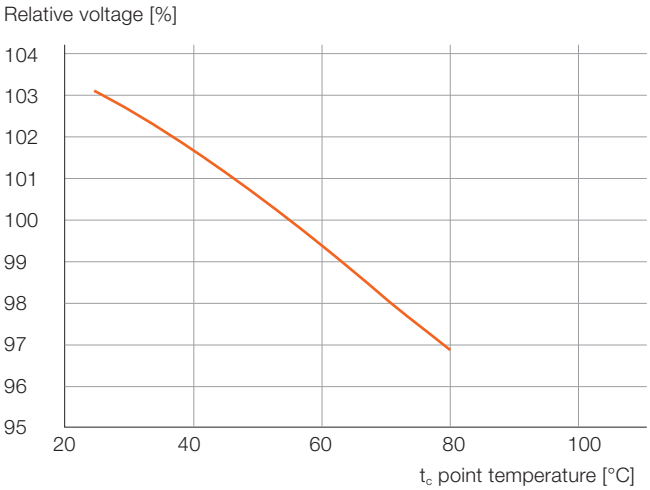




5.3 Forward voltage as a function of t_c point temperature

The diagram on the right shows the relative dependence of the forward voltage on the temperature at the t_c point of the LED module (down to a temperature of 20 °C). The voltage increases with decreasing temperature. Therefore, when looking for a suitable LED driver, the forward voltage of the cold system at the coldest specified temperature has to be considered.

Relative forward voltage as a function of t_c point temperature



6 Lifetime and lumen maintenance

For the definition of the lifetime of an LED module, see IEC/PAS 62717, where the following types are defined:

The luminous flux of an LED module decreases over its lifespan. This decrease is specified by the L value. LXX means that XX % of the initial light output is emitted by the LED module (e.g. L70 = 70 %). The L value is always connected to an operating time and defines the lifetime of an LED module. Please be aware that the L value is a statistical value. Therefore, the decrease in light output can and will vary for different modules.

The B value specifies how many LED modules are below a stated limit, e.g. B50 means that 50 % of the LED modules are below a given L value.

The C value gives the number of fatal failures, meaning the number of LED modules that are destroyed and do not emit any light at all (e.g. C10 after 50000 hours means that after 50000 hours in operation, 10 % of the LED modules do not emit any light).

The F value is the combination of the B and C value, meaning that both fatal failures and degradation are considered.

Some examples:

- L0C10 is the lifetime where the light output is 0 % for 10 % of the LED modules.
- L70B50 is the lifetime where the light output is ≥ 70 % for 50 % of the LED modules. The B value includes only gradual reduction of lumen output over time (not the abrupt flux degradation).
- L70F50 is the lifetime where the light output is ≥ 70 % for 50 % of the LED modules. The F value includes reduction of lumen output over time including abrupt degradation (flux = 0).

Basic Linear G2 LED modules have a lifetime of 50000 hours (L80B50) at a t_c point temperature of 55 °C. This means that after 50000 hours, a minimum of 50 % of the utilized LED modules will maintain at least 80 % of the initial luminous flux.

Please note:
A higher t_c temperature leads to a shorter lifetime of the LED module. Moreover, the failure rate will also increase.

Illustration of the temperature-dependent lumen maintenance (B10) at current I_{nom} and CRI >80

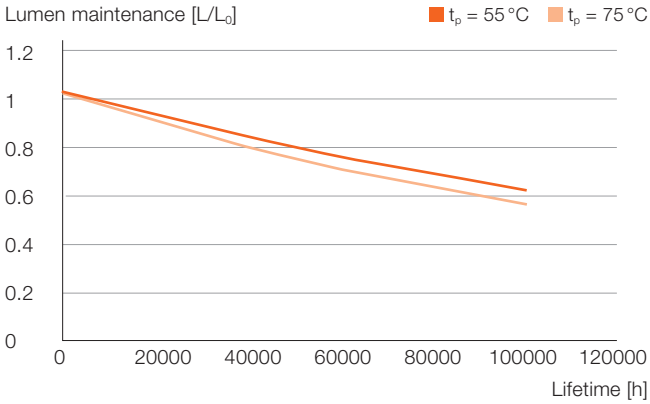
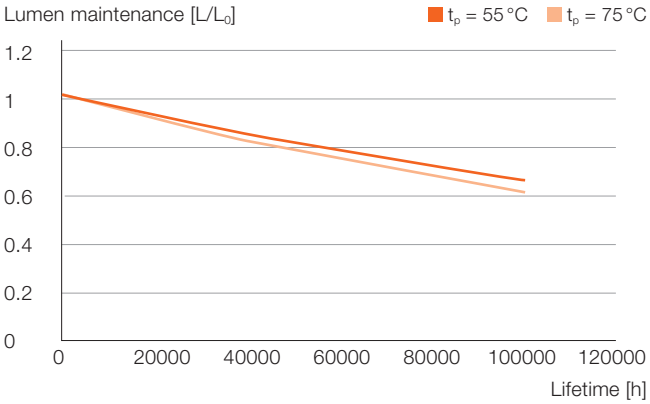


Illustration of the temperature-dependent lumen maintenance (B50) at current I_{nom} and CRI >80



Lifetime data

	LxBy						
	x	70		80		90	
	y	10	50	10	50	10	50
	[mA]	Lifetime [h]					
t_p = 45 °C	I_{rated}	>60000	>60000	51000	53000	25000	26000
t_p = 55 °C	I_{rated}	>60000	>60000	47000	50000	23000	25000
t_p = 65 °C	I_{rated}	>60000	>60000	43000	46000	21000	23000
t_p = 75 °C	I_{rated}	>60000	>60000	39000	43000	19000	21000
t_p = 80 °C	I_{rated}	59000	>60000	37000	41000	18000	20800

7 Mechanical considerations

7.1 LED module dimensions

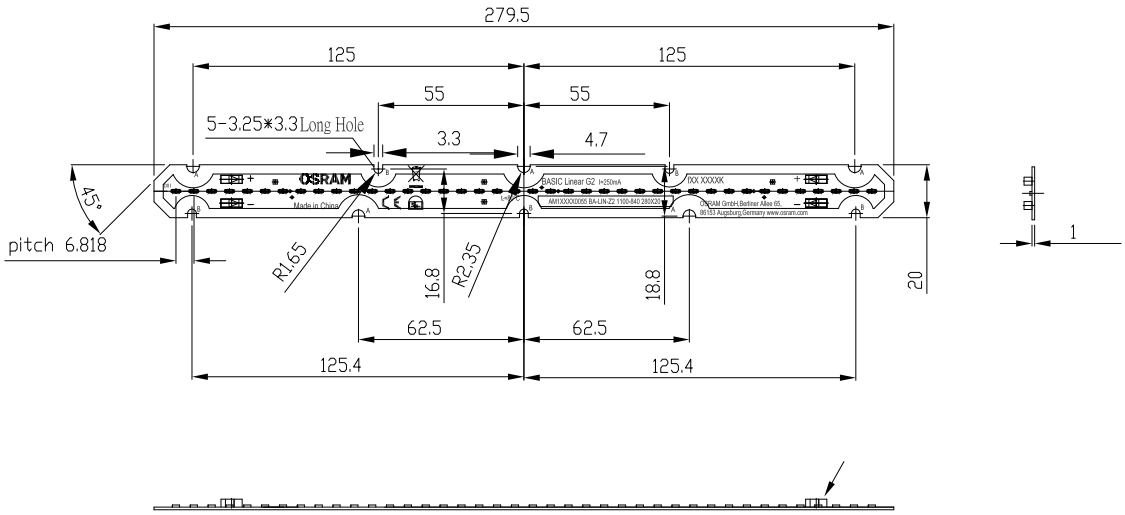
The Basic Linear G2 family has three types of LED module dimensions:

- 280 mm x 20 mm x 5 mm
- 560 mm x 20 mm x 5 mm
- 1120 mm x 20 mm x 5 mm

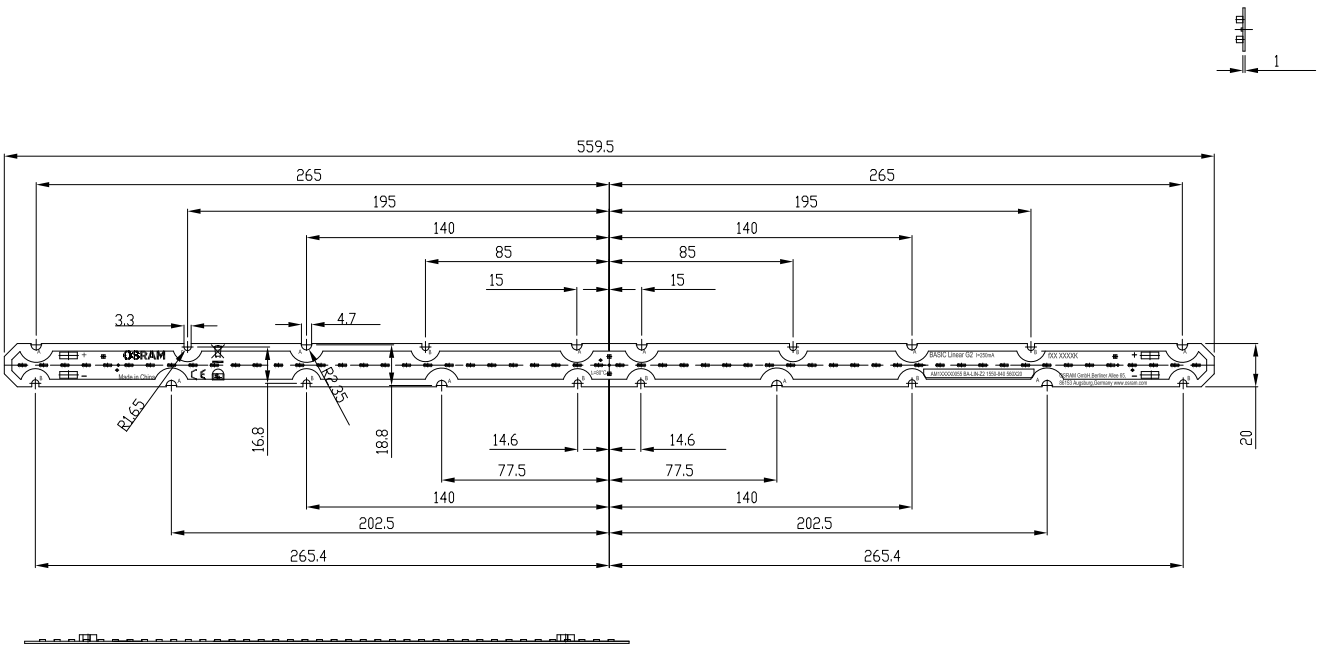
The different module lengths are available with the following nominal luminous fluxes:

- 280 mm: 1100 lm
- 560 mm: 1550, 2200 lm
- 1120 mm: 4400 lm

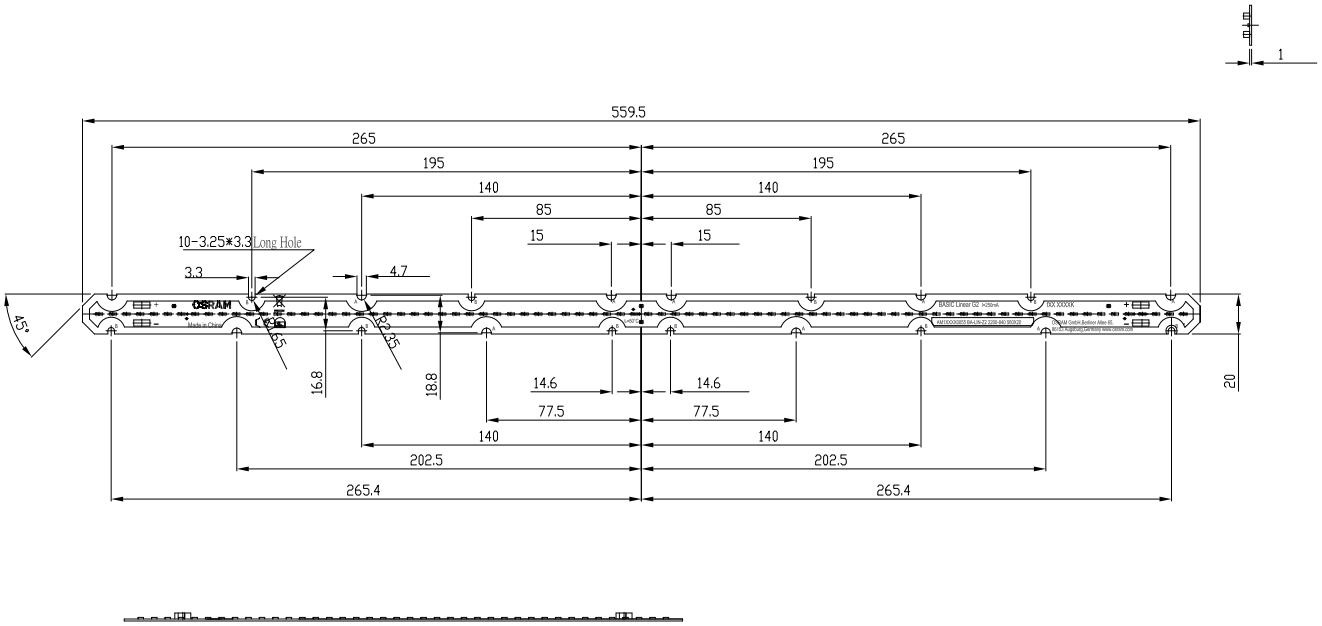
Basic Linear G2: BA-LIN-Z2 1100-8xx 280X20



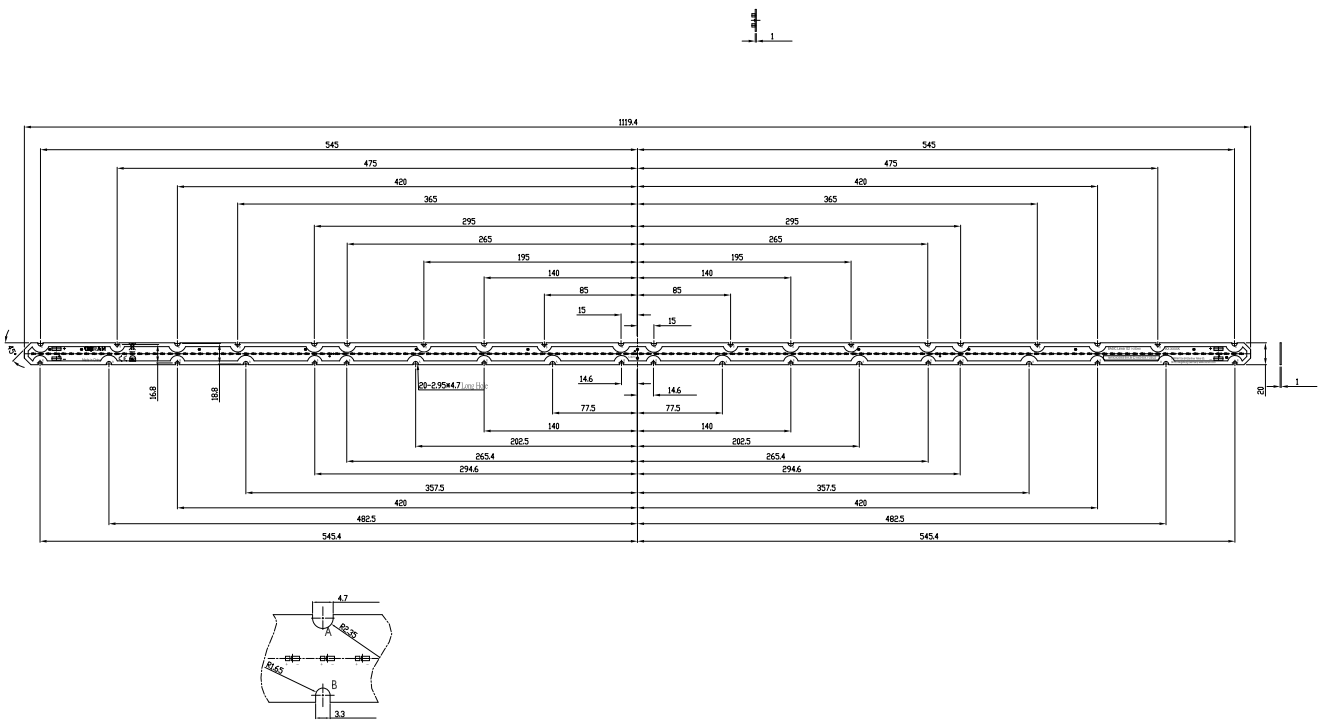
Basic Linear G2: BA-LIN-Z2 1550-8xx 560X20



Basic Linear G2: BA-LIN-Z2 2200-8xx 560X20



Basic Linear G2: BA-LIN-Z2 4400-8xx 1120X20



Module dimensions overview

	L [mm]	W [mm]	H1 (PCB thickness) [mm]	H2 (LED module height) [mm]
BA-LIN-Z2 1100-8xx 280X20	279.50	20	1	4.3
BA-LIN-Z2 xxxx-8xx 560X20	559.50	20	1	4.3
BA-LIN-Z2 4400-8xx 1120X20	1119.40	20	1	4.3

7.2 Number of LEDs, LED pitch

Number of LEDs and LED pitch for the different modules in the Basic Linear G2 family

Product name	Number of LEDs	Pitch [mm]
BA-LIN-Z2 1100-8xx 280X20	40	7.0
BA-LIN-Z2 1550-8xx 560X20	56	10.0
BA-LIN-Z2 2200-8xx 560X20	80	7.0
BA-LIN-Z2 4400-8xx 1120X20	160	7.0

7.3 Mechanical protection

For operation in damp, wet or dusty environments, the user has to make sure that an adequate ingress protection (IP) is chosen. The LED module has to be protected by a suitable IP rating of the luminaire housing. Please consider the luminaire standard IEC 60598 as well as the different requirements.

7.4 Mounting instructions

Please apply force only to the dedicated mounting positions. Strong mechanical stress can lead to irreversible damage of the LED module. To fix the module to the fixture, you can use M4 screws according to DIN 7984 or DIN EN ISO.

The maximum allowed screw head diameter without using an isolating washer between the screw and the mounting hole is 7.5 mm. With larger screw heads, the minimum distance between the screw and other conductive parts on the Basic Linear G2 LED module can be below the limit for creepage distances.

The maximum torque that should be applied on the screws depends on factors such as the screw type and the luminaire material. It is also influenced by the usage of washers. In most cases, a torque between 0.5 Nm and 1 Nm is enough to fix the LED module in the luminaire housing and will not damage the module.

Possible screws

Cylinder head, torx drive	**M4 screw (ISO 4762)**	
Diameter	4.0 mm	
Head diameter	7.0 mm	
Head height	4.0 mm	
Flat head, button head Torx drive, hex drive	**M4 screw (ISO 7380)**	
Diameter	4.0 mm	
Head diameter	7.5 mm	
Head height	2.1 mm	

It is also possible to use clips instead of screws, e.g. the push-to-fix (P2F) connectors from BJB: www.bjb.com.

To achieve optimal fixation of the LED module and also optimal thermal management, it is recommended to use all mounting holes in the Basic Linear G2 LED modules. Nevertheless, it is possible to reduce the number of screws, but in that case thermal behavior and mechanical strength has to be verified.

In any case, it is strongly recommended to perform mechanical and thermal testing of the LED modules in the luminaire.

8 Safety information

- The LED module itself and all its components must not be mechanically stressed.

  The modules are intended for operation only with matching OPTOTRONIC®.
  To also ease the luminaire/installation approval, electronic control gear for LEDs or LED modules should carry the CE mark and be ENEC-certified. In Europe, the declarations of conformity must include the following standards: CE: EC 61347-2-13, EN 55015, IEC 61547 and IEC 61000-3-2 – ENEC: 61347-2-13 and IEC/EN 62384.

  Also check for the mark of an independent authorized certification institute.

  Please see the relevant brochure for more detailed information (see “Related and Further Information”).

- Installation of LED modules (with power supplies) needs to be made with regard to all applicable electrical and safety standards. Only qualified personnel should be allowed to perform installations.
- Pay attention to standard ESD precautions when installing the module.
- Photobiological safety according to IEC 62471, risk group RG1
- Max. voltage U-OUT = 250 V for operation on non-isolated and SELV LED control gear

Use our contact form

www.inventronics-light.com/contact-us

Service contact:
Inventronics GmbH
Parkring 31-33, 85748 Garching, Germany
www.inventronics-light.com
support@inventronicsglobal.com

inventronics