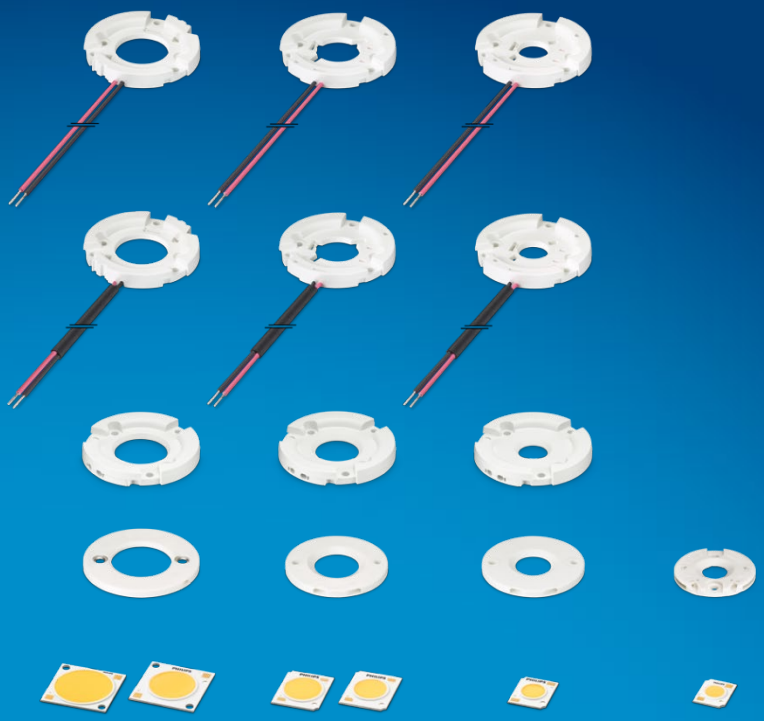
PHILIPS

LED Systems

Point

SLM and SLM VO



SLM Design-in Guide

New levels of **brightness** and **saturation** in retail

March 2023

Published versions
22 October 2021
13 March 2023

Contents

Introduction to this guide

Fortimo LED SLM modules and holders

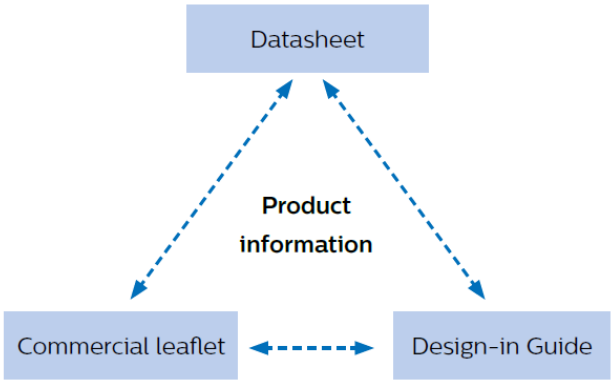
Thank you for choosing the Philips Fortimo LED SLM. In this guide you will find the information required to design this module into a luminaire.

Extensions to the range will be included in future updates of this guide. We advise you to consult our website for the latest up-to-date information. For a full portfolio overview please consult the Commercial Leaflets, to be found in the download section on:
www.philips.com/oem

Product information documents

In order to provide information in the best possible and consistent way, Philips' philosophy on product documentation is the following.

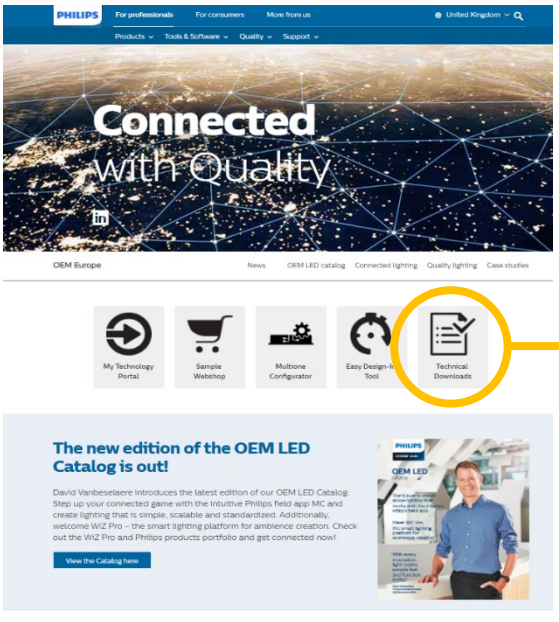
- Commercial leaflet:
  product family overview & system combinations.
- Datasheet:
  product specific specification.
- Design-In Guide:
  describes how to design-in the products into a system.



These documents can be found in the download section on the OEM website:
www.philips.com/oem

If you need any further information or support, please, consult your local Philips office.

Note that this triangle of information is also available for the drivers separately.



Download section of the OEM Website

Safety warnings and installation instructions

Warning:

- Use SELV drivers only !
- Avoid touching live parts !
- Do not use damaged LED modules !
- Avoid touching the Light Emitting Surface

Design-in phase

- Do not apply mains power to the module (Philips Fortimo LED SLM CoB and holder) directly.
- Connect the modules and drivers before switching on mains.
- Provide adequate environmental protection
- Due to the Tcase nominal temperature of the Fortimo LED SLM of 85 °C, it is important to take into account the maximum touchable metal surface temperatures of the luminaire. With such a high Tc temperature the maximum temperature for touch safety can easily be exceeded. In that case the luminaire must be mounted out of reach.
- Avoid contamination (direct or indirect) from any incompatible chemicals reacting with the silicone. A list of incompatible chemicals is provided in the chapter for Compliance and Approval.
- The general IEC recommendations for luminaire design and legal safety regulations (ENEC, CE, ANSI, etc.) are also applicable to Philips LED Linear systems. Luminaire manufacturers are advised to conform to the international standards for luminaire design (Class I, IEC 60598-Luminaires).
- The luminaire must be constructed in such a way that the LED module cannot be touched by an end-user, both in off state and when live.
- The LED module shall be powered by a LED controlgear IEC/EN 61347-2-13 certified.
- Avoid possibilities of water or dirt ingress: use appropriate IP-rating of luminaire with regard to specific conditions of application.

Manufacturing phase

- Do not use products in case the phosphor on the CoB is discolored/ scratched or if the holder is broken.
- Do not use damaged or defective LED modules, including damaged connectors or PCB.
- Do not drop the LED module or let any object fall onto the LED module because this may damage the PCB or LEDs. If the LED module has been dropped or an object has fallen onto the LED module, do not use it, even if there are no visible defects or signs of damage.
- Connect all electrical components first before switching on mains.
- Avoid contamination (direct or indirect) from any incompatible chemicals reacting with the silicone. A list of incompatible chemicals is provided in the chapter for Compliance and Approval.

Installation and service

- Do not service the luminaire when the mains voltage is connected; this includes connecting or disconnecting the LED module cables.
- Do not use damaged products.

Philips Design-in support

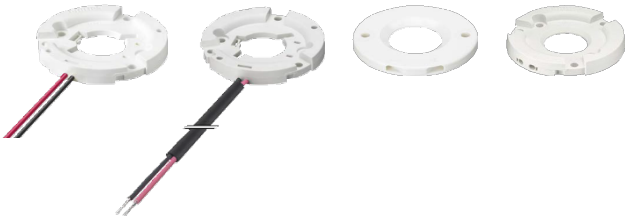
Is available; please contact your Philips sales representative.

System disposal

Please inform yourself about the local waste disposal, separation and collection system for electrical and electronic products and packaging. Please act according to your local rules and do not dispose of your packaging and old product with your normal household waste. The correct disposal of your product will help prevent potential negative consequences for the environment and human health.

Introduction to the SLM system

Chip on Board (CoB) modules



CoB holders

Application Information

The Philips Fortimo LED Spotlight Module (SLM) is a high-performance, compact, and cost-effective series of products for general and accent lighting.
This product offers a long-lifetime and energy efficient lighting solution for retail, hospitality, and general down-lighting applications. It is consistent with other Fortimo families of modules, delivering a high quality of light and peace of mind.

Module types

The SLM module comprises of a range of CoB's that can be used without a holder, or can be paired withthe following holders:

- A standard holder with fitted pre-tinned cables (with or without a sleeve)
- A poke-in holder

An overview is provided in the CommercialLeaflet in the download section on www.philips.com/oem
The user can choose to operate any of these modules at different currents to obtain a requiredlumen output.
With the Fortimo SLM, the user has the flexibility to choose amongst a wide range of CoB's and pair it with any of the available holders. The drive current of a CoB can be tuned to achieve a high lm/W or a high lm/€. This provides the user with a full portfolio comprising a wide range of products.

Note:
The system warranty is valid only if the complete system (CoB + driver) is used. The OEM is free to choose a holder provided (a complete list can be found in the commercial leaflet or in the datasheet of the holders, both of which can be found at www.Philips.com/technology), or to use the CoB without a holder and soldering wires on to it.

Choosing the Correct Fortimo LED SLM module

The Fortimo SLM module is offered in a wide range of options. Please refer to the appropriate datasheets for details about each module. This module can then be used at several different operating points to suit your needs.

CoB Types and Holders

In this design-in guide you will find all necessary guidelines to configure the Fortimo LED SLM moduleto exactly fit your needs.

The range consists of a wide selection of of Chip-on-Board (CoB) products:

- Standard versions in various lumen packages andcolours; on the black body line.
- Premium White in various lumen packages and colours; below the black body line providing animproved white perception.
- SLM CrispWhite: An optimized spectrum for retail, providing intense whites and rich colours.
- SLM Food Warm White: A specific spectrum that enhances the appearance of fresh food.
- SLM Food Premium Red: A specific spectrum that the appearance of fresh meat.
- The initial purpose of this product is for retail lighting applications, more specifically for e.g., food, furniture and leather. The product is not intended for use in other applications.

Name of the CoB

Fortimo SLM Y 830 XX 1208 L15 2024 GNi ZZ

Fortimo:	Our brand name for high quality, efficient, smart, future proof, and reliable LED lighting
SLM:	Spot Light Module
Y:	C = no special meaning (originally: CoB) VO = Value Offer
830:	8 stands for a color rendering index >80 - 30 stands for a CCT of 3000 K
XX:	Spectrum Blank = Standard PW = Premium White PC = Premium Color CW = Crisp White FPR = Food Premium Red FWW= Food Warm White FLS = Food Live Seafood FIS = Food Iced Seafood FVF= Food Vegetable and Fruit
1208:	CoB size
L15:	Diameter of the Light Emitting Surface (LES), in this case 15mm
2024:	Holder dimensions, can be matched with the naming of holder X
Gxi:	x = Generation number i = Additional mark, indication for CoB shape or performance indicator Blank = rectangular dimensions (footprint) N = square dimensions (footprint) + = version optimized for narrow beam
ZZ:	HE=CRI90 with high Efficacy

Name of the Holder

FORTIMO SLM H YY 2024 Lxxx G1

Fortimo:	Our brand name for high quality, efficient, smart, future proof, and reliable LED lighting
H:	Holder
YY:	Holder version Blank = standard version DL = Down Light version PI = Poke-In version ZP = Zhaga Poke-in version
2024:	Dimensions of the CoB-cavity in the holder, to be matched with the dimensions of the CoB
Lxxx:	For Holders with wire: xxx mm wire length
G:	Generation

Label/Marker of a CoB

On ordering a Fortimo SLM CoB, the customer will receive a box stating the CoB type. Apart from this, each CoB has a printed label on it describing the color and CoB type to enable easy identification. There are two types of markers, one that was on CoB's until Fortimo SLM G6 and another from CoB's of G7 and further. The following is a description of the identification on the CoB:

Marker until Fortimo SLM G6 - YYZZ X 12xx

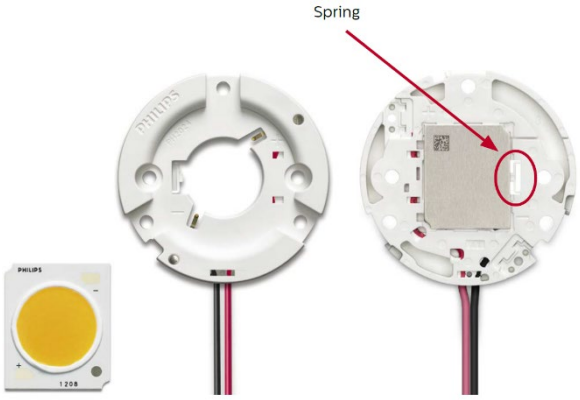
YY (CTT)	ZZ (CRI)	X (Spectrum)	12xx (CoB type)
CRI/10	CCT/100		
7 = CRI 70	22 = 2200K	Blank = Standard	1201
8 = CRI 80	25 = 2500K	P = Premium White	1202
9 = CRI 90	27 = 2700K	L = Premium Color	1203
	30 = 3000K	C = Crisp White	1204
	35 = 3500K	R = Food Premium Red (Meat)	1205
	40 = 4000K	F = Food Warm White (Food)	1206
	50 = 5000K		1208
	65 = 6500K		1210
			1211
			1212
			1216

Marker for Fortimo SLM C 830 PW 1211 L19 2828 G6

Marker for Fortimo SLM C 940 PW 1211 L19 2828 G7

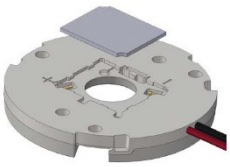
Marker until Fortimo SLM G7 - ABBC12xxDEF

A (CRI)	BB (CCT)	C (Spectrum)	12xx (CoB type)	D (Family)	E (Portfolio	F (generation)
CRI/10	CCT/100					
7 = CRI 70	22 = 2200K	Blank = Standard	1201	F = Fortimo	Space/Blank = Standard	1
8 = CRI 80	25 = 2500K	P = Premium White	1202	N = Fortimo New Formfactor	H = High Density (HD)	2
9 = CRI 90	27 = 2700K	L = Premium Color	1203	V = Fortimo VO	X = High Efficacy CRI 90	3
	30 = 3000K	C = Crisp White	1204			4
	35 = 3500K	R = Food Premium Red (Meat)	1205			5
	40 = 4000K	W = Food Warm White (Food)	1206			6
	50 = 5000K	F = Food Live Seafood/	1208			7
	65 = 6500K	Iced Seafood	1210			.....
		V = Food Vegetable and Fruit	1211			
			1212			
			1216			

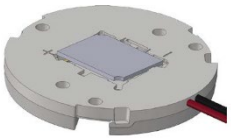


Assembling your Fortimo LED SLM module

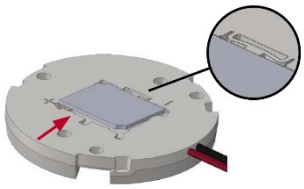
To assemble the two, please ensure that the + and – sign on the CoB are aligned with that on the holder. The CoB must be clicked into the slot by pushing back onto the spring. The pictures on the next page explain this process step by step.



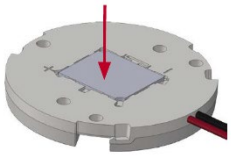
Step 1: Align the + and – of the CoB and holder



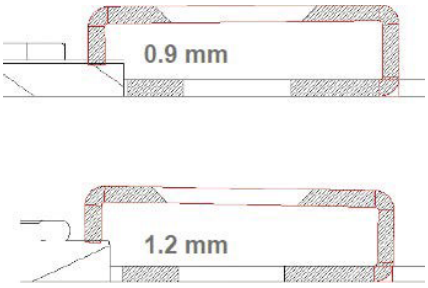
Step 2: Place the CoB against the spring at an angle



Step 3: Compress the spring with the CoB



Step 4: Click the CoB down into the holder



Note:
For the poke-in (PI) holder for L19, a provision is made to incorporate CoBs of various thickness. Two stainless steel clamps are integrated within the holder and are activated by screwing down into the heat sink. Depending on the type of CoB used, there may be no contact with the heat sink once inserted into the holder. When clamps are screwed down, the CoBwill have a good thermal down force. It is a metal, mechanically closed, system so there will be no plastic creepage.

Each CoB can be paired with any of our available holders (standard: with fitted pre-tinned cables, downlight: with fitted pre tinned cables witha sleeve and poke in) to give full flexibility and freedom to the customer.
The pre-tinned cables come in a length of 60 cm.The OEM can cut this to the length required. However, in the case of downlight versions where the cables are in a sleeve, this is not advised.

Note:
It is advised to avoid sharp corners in your luminaire where the wires need to pass. This is done to avoid damage to the insulation of wires. On top of this broad range in standard settings and building blocks, the Fortimo LED SLM portfolio provides the luminaire manufacturer with a high level of flexibility to obtain a specific luminaire performance, while using the same components. In combination with our Xitanium LED drivers, the user has the possibility to drive their module at different currents to achieve a high lm/W or a high lm/€ at different lumen outputs.

Holder types for Fortimo SLM

The Fortimo SLM system can be supplied with a selection of CoBs and holders. In this section, we describe the differences in the holder types:

1. Holder with Pre-tinned Cables
   Each CoB can be bought in combination with this holder. The length of the cable is by default 600mm, but the customer can cut it to the appropriate length if needed. There is a version with 280mm available as well.
2. Holder with Tin-dipped Cables, with a sleeve (60 cm)
   These holders are available if the Fortimo SLM module must be used in a downlight application. It is not advised to cut the length of this cable. Available in two lengths: 280mm and 600mm.
3. Poke-in holder
   The absence of cables on the holder, allows for late-stage configuration. Please note that this holder has a different height than the other two versions. Details of the dimensions are provided in the datasheets available at www.philips.com/oem.
4. Zhaga Poke-in holder
   This holder comes without cables to allow the customer flexibility in production flow, like the poke-in holder. Otherwise, this holder is the same as the standard holder in dimensions and properties.

Holders for Fortimo SLM VO

Signify will release holders for SLM VO. Holders are already available at third parties.

Some features vary between the holders. The table below shows a summary of differences.

Standard/downlight version	Poke-in version	Zhaga Poke-in version
Fitted with pre tinned cables (with/without a sleeve)	No cables attached	No cables attached
CoB clicked in by pushing against the spring	CoB clicked in by pushing against the spring for the holders catering to LES 9 – 15. The holder for LES 19 has a different mechanism. Two metal springs are provided. The holder can be pressedagainst the CoB to click it in.	CoB clicked in by pushing against the spring
ENEC+ certified	Not ENEC certified	ENEC+ certified
Zhaga compatible	Not Zhaga compatible except for the position of the screw holes.	Zhaga compatible
Height is higher than the poke-in version	Lower (dimensions available in datasheets)	Height same as the standard version
3 screw holes available, along with 2 Zhaga compatiblescrew holes	Only the Zhaga screw holes are available	Screw holes same as the standard version
Daisy chaining allowed for a voltage <=150 V	Daisy chaining not allowed	Daisy chaining allowed for avoltage <=200 V
Provision to feed through a thermo couple wire to usethe T sense point	No such provision	Provision to feed through a thermo couple wire to usethe T sense point
Late stage configuration not possible	Late stage configuration possible	Late stage configuration possible
Provision for easy reflector attachment	No provision for reflector attachment	Provision for easy reflector attachment

Impact of Choice of Holder on Flux Output

Depending on the CoB in question, the choice of holders can have a small impact on the flux output. Please refer to the table below for more information.

Flux Output

CoB type	Bare CoB	Standard/DL-Holder	Poke-in Holder	Zhaga PI Holder
1202	100.00%		99.20%	
1203	100.00%	98.30%	99.70%	99.30%
1205	100.00%	98.60%	99.20%	99.50%
1208	100.00%	98.50%	99.50%	99.10%
1211	100.00%	98.70%	99.50%	98.80%
1216	100.00%		98.90%	
Average:	**100.00%**	**98.60%**	**99.30%**	**99.20%**

Notes:

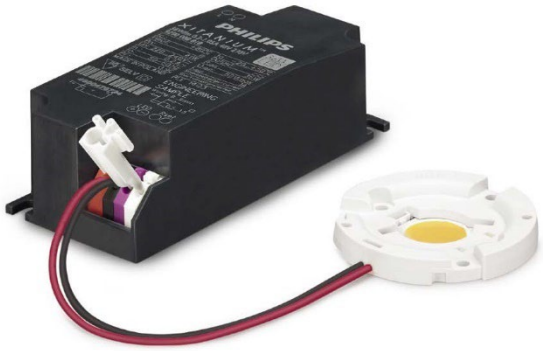
- It is possible to use the Fortimo SLM CoB's without a holder. The wires can be soldered on the CoB.
- In case the OEM needs to supply luminaires to North America, there may be differences in regulations. Please check with your sales representative or contact the Design- in team.

Can the Fortimo LED SLM module be used in outdoor applications?

Yes, the Fortimo SLM products can be used in outdoor applications. However, please note that neither the Fortimo LED module nor the Indoor PointLED driver has an IP classification. For outdoor applications, we recommend that wires are soldered on instead of using a holder. If these products are used in luminaires for outdoor applications, it is up to the OEM to ensure proper protection of the luminaire. Also, other aspects like surge protection must be considered. Please, consult us if you wish to deviate from the design rules described in this guide.

Xitanium LED drivers for Fortimo LED SLM

These highly efficient LED drivers are designed for the Fortimo LED modules. These are available as a built-in or independent driver, dimmable or with a fixed output. More information about the Xitanium drivers for Fortimo LED SLM modules can be found in the Xitanium indoor down and spotlight driver design in guide and the Xitanium commercial leaflet. These documents can be downloaded via www.philips.com/oem . The Xitanium driver datasheets can also be downloaded on this website. Full system overviews can be obtained using the Easy Design-in tool at www.easydesignintool.philips.com.

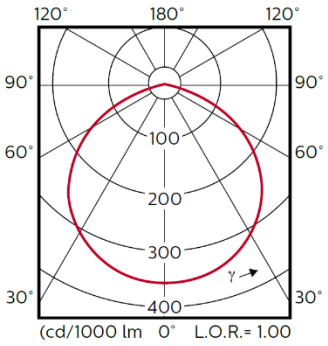


Fortimo LED SLM module

Optical Design-in

Light distribution

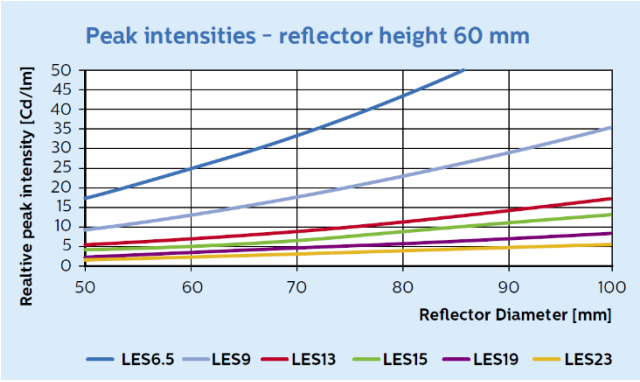
Fortimo LED SLM generates a Lambertian beam shape (see light distribution diagram). The secondary optics design should not cover the exit aperture. We provide near-field ray-set files on our website www.philips.com/oem.

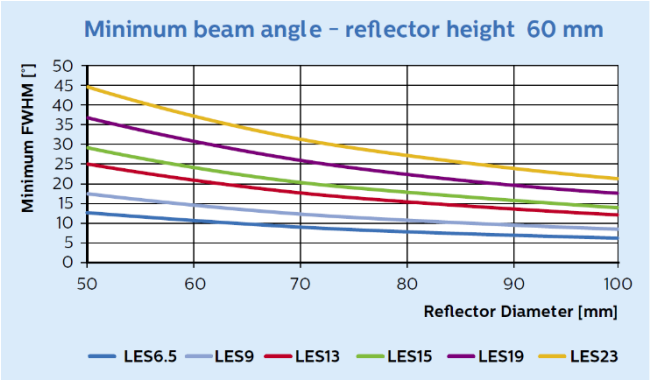


Light distribution diagram

Reflector design limits

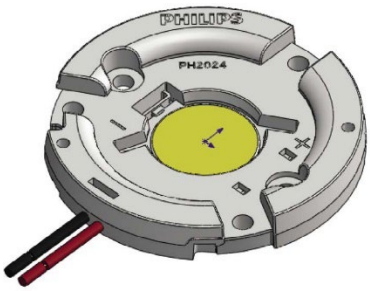
The graphs below give an indication of the relation between the diameter of the reflector exit aperture and the minimum beam angle (FWHM) or beam peak intensity that can be achieved with Fortimo LED SLM modules.





Ray sets

The following ray set files are available for customer use and can be downloaded from www.philips.com/oem.
All Ray set files are available containing 100,000, 500,000 and 5,000,000 rays.



Software	File extension
ASAP	.dis
Light Tools (ASCII)	.ray (zipped)
TracePro/Oslo (ASCII)	.dat (zipped)
Zemax	.dat

The origin of the ray sets is shown in the pictures on the left, and it coincides with the origin of the CAD file:

- X = 0 and Y = 0 at the center of the module.
- Z = 0 at the emitting surface (2 mm below the inner flat surface of the cover).

Note:
The ray set files provided are general and can be used in most applications for all released CCT's, CRI's and holders. Specific ray sets for a certain color or holder are available on request, if needed.

Color consistency

Color consistency refers to the spread in color points between modules. It is specified in SDCM (Standard Deviation of Color Matching) or MacAdam ellipses, which are identical. The current general specification of all the Fortimo LED SLM modules is 3 SDCM. This results in an excellent color consistency performance.
For SLM HE versions, color consistency is even better: 2 SDCM.

Color targets

The color target points of the Fortimo LED SLM modules are found in the respective datasheets on www.philips.com/oem.

Spectral light distribution

The typical spectral light distributions of the Fortimo LED SLM colors are shown in the respective datasheets on www.philips.com/oem.

Complementary partners for Secondary Optics

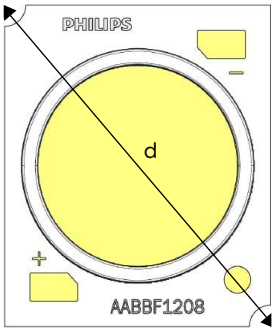
Secondary optics is not part of the Fortimo LED SLM system offering. This is an added-value area for OEMs, offering the possibility to differentiate. The OEM can choose between reflectors and lenses. The use of reflectors is often preferred for a high light output ratio and glare shielding. Lenses however offer full beam control and can be more compact. There are many reflector companies that have a standard portfolio of compatible reflectors available, enabling quick and easy luminaire creation. A list of complementary partners offering compatible optics for Fortimo LED SLM modules is provided at the end of this document.

Reference to these products does not necessarily mean they are endorsed by Signify. Signify gives no warranties regarding these products and assumes no legal liability or responsibility for any loss or damage resulting from the use of the information given here.

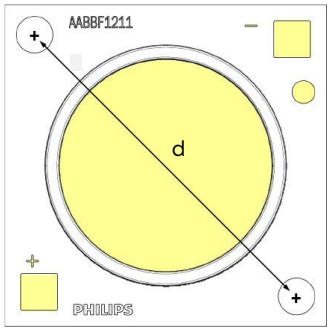
Starting characteristics

The Fortimo modules light up milliseconds after being switched on, which is a general characteristic of LEDs.

Mechanical Design-in



Dimension d for 1202-1210



Dimension d for 1211-1216

Fortimo SLM N CoB	Outer Dimensions	Distance d: M2 screws	Distance d: M3 screws
1201	13.5mm x 13.5mm	NA	19.09mm
1202			
1203			
1204			
1205	19mm x 19mm	NA	26.87mm
1206			
1208			
1210			
1211	28mm x 28mm	NA	32.24mm
1212			
1216			

Fortimo SLM CoB	Outer Dimensions	Distance d: M2 screws	Distance d: M3 screws
1202	12mm x 15mm	17.98mm	19.78mm
1203	16mm x 19mm	24.55mm	25.28mm
1204			
1205	20mm x 24mm	30.95mm	32.28mm
1211	28mm x 28mm	NA	32.28mm
1216			

Fortimo SLM VO CoB	Outer Dimensions	Distance d: M2 screws	Distance d: M3 screws
1205	19mm x 19mm	NA	26.87mm
1206			
1208			
1211	28mm x 28mm	NA	32.24mm

Fortimo LED SLM module dimensions

3D CAD files can be downloaded from our website: www.philips.com/oem. Basic dimensions for each module can also be found in the datasheets which are also available at this website.

Recommended torque

The recommended torque for mechanical fixation of the Fortimo LED SLM modules to the heat sink is 0.226 Nm (assuming pre-taped holes are present in the heat sink).

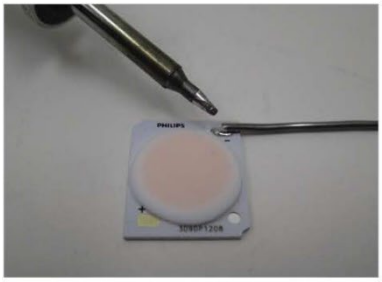
Wires for SLM Poke-in versions

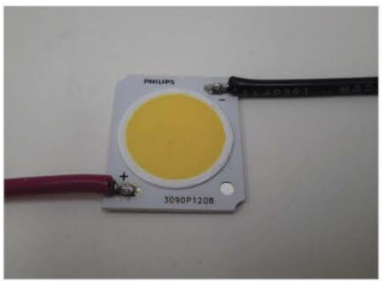
The Poke-in holder supports 18-22 AWG (0.35 - 0.75mm2) solid, fused and stranded wires. It can be placed using M3 type crews.

Using the CoB without a holder

The Fortimo SLM CoB's can be used without a holder. For this, wires need to be soldered on. The following process can be followed:

1. Prepare the heat sink
2. Ensure that the heat sink surface is clean and flat (≤ 25um), with no crowns or peaks in the mounting area; crowns or peaks on the heat sink surface may adversely impact the thermal conductance between the CoB and the heat sink.
3. Drill and tap two M2 or M3 screw holes according to the information in the picture on the left.
4. Wipe the heat sink surface clean with isopropyl alcohol (IPA).
5. Apply a thermal interface material (TIM) onto the heat sink.
6. Place the CoB onto the heat sink and align the screw slots in the substrate with the tapped screw holes in the heat sink.
7. Secure the CoB to the heat sink with two M2 or M3 screws. The screw down torque should not exceed 0.226Nm.
8. Fortimo SLM CoB's can be used with holders from complementary partners like BJB an Ledil as well.





Recommended soldering process

Recommended soldering process

Wires can be directly soldered onto the CoB emitter.
The following supplies are needed to do so:

- Grounded soldering iron, capable of reaching 350 °C (a soldering iron with a power level >30W is recommended)
- Stranded or solid copper wire – 24 gauge or larger
- Low-flux Sn96Ag4 solder wire
- Hot-plate, capable of reaching 100 °C (optional)

Follow the steps below to attach the wires to the CoB emitter.

1. Prepare the wires.
   a. Cut the wires to size.
   b. Strip a few millimeters of insulating material from the ends of the wires.
   c. Pre-tin the wires with a small amount of solder.
2. Prepare the pads.
   a. Clean the pad.
   b. Place the tip of the soldering iron on the pad, apply solder and allow it to wet the pad.
3. Solder the wires to the pads.
   a. Place the pre-tinned wire on the pad.
   b. Place the tip of the soldering iron on the pad and allow the solder to reflow around the wire.
   c. Remove the soldering iron and allow the solder to joint to cool.

Recommendations

1. Preparation
   a. Wear the wrist strap before operation.
   b. Do not touch LED during the operation.
   c. Wire cross-section area should be 0.2...0.75 mm2 (18...24 AWG), solid and fine stranded.
2. Soldering temperature
   a. Soldering bit temperature shall be 350 °C or less.
   b. The substrate of the CoB emitter is designed to dissipate heat quickly. This may make it difficult to get the temperature of the electrical pads to a point where the solder will reflow.
   Therefore, it is important to place the CoB emitter on a thermally insulating surface.
   Alternatively, place the CoB emitter on a pre-heated hot plate set to 100 °C.
   c. Do not place the soldering iron on the pad for more than 3 seconds.
3. It is highly recommended that the module's light emitting surface be covered when wires are soldered to the CoB emitter. If solder flux or debris lands on the light emitting surface, it will lead to performance impact and will void the warranty.

Thermal Design-in

The critical thermal management points for the LED module are set out in this chapter in order to facilitate the design-in of Fortimo LED spotlight modules (SLM). If these thermal points are taken into account, this will help to ensure optimum performance and lifetime of the LED system.

Optimum performance

To ensure optimum performance, the Fortimo LED SLM system must operate within specified temperature limits.

Test requirements

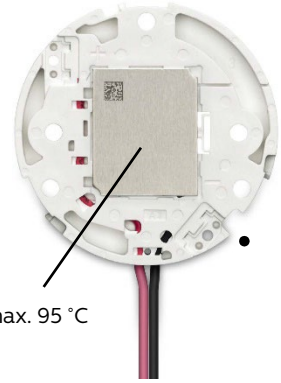
Measurements, e.g. of temperature, luminous flux and power, are reliable once the luminaire is thermally stable, which may take between 0.5 and 2 hours, and is defined as at least 3 readings of light output and electrical power over a period of 30 minutes taken 15 minutes apart with stability less than 0.5%. The time depends on the thermal capacity of the luminaire (see also the relevant clauses in IEC 60598-1).

Note:
Thermal stability can be considered if the temperature changes are less than 1 °C over three measurements taken 15 minutes apart. Measurements must be performed using thermocouples that are firmly glued to the surface (and not, for example, secured with adhesive tape).

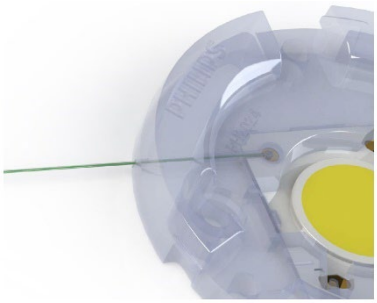
Critical measurement points

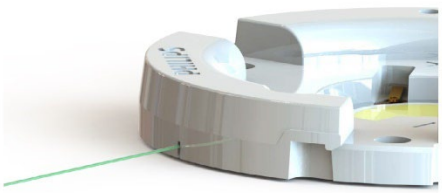
Because LEDs are temperature sensitive, LED modules require a different approach with respect to the maximum permissible component temperature. This is different to most other types of conventional light sources. For LEDs the junction temperature is the critical factor for operation. Since there is a direct relation between the case temperature and the LED junction temperature, it is sufficient to measure the aluminum casing of the LED module at its critical point. The critical point is on the rear surface of the LED module, as shown in the figure on the left. If the case temperature (Tc) at the critical measurement point exceeds the recommended maximum temperature, the performance of the LEDs will be adversely affected, for example in terms of light output, lifetime or lumen maintenance.

To aid easy design-in of the Fortimo LED SLM, a Tsense point is introduced at the top side of the LED module. The Tcase point at the back remains leading. However, under certain circumstances, the temperature measurements on the Tsense point can be used to predict the temperature of the Tcase point at the back of the module. For this purpose, there is a provision in the SLM holder (with the exception of the poke-in version) to feed through a thin thermal couple wire. The correlation between the Tsense point and the Tcase point is influenced by the quality and performance of the thermal interface with the heat sink and the type and geometry of the heat sink. The correlation between Tsense and Tcase has been calculated based on laboratory test with thermal paste and heat sinks with at least 3mm heat sink base thickness. If these conditions are the same, then a difference of 0.3°C/W can be used for 3mm thick heat sinks. For thicker heat sinks, the difference will be smaller. Results may vary case by case, and it is best if the measurement reference is made at the customer, using the luminaire in question. A heat sink thickness of at least 3mm is recommended. If support is needed, please ask your Signify representative about our design-in service.



Tcase max. 95 °C

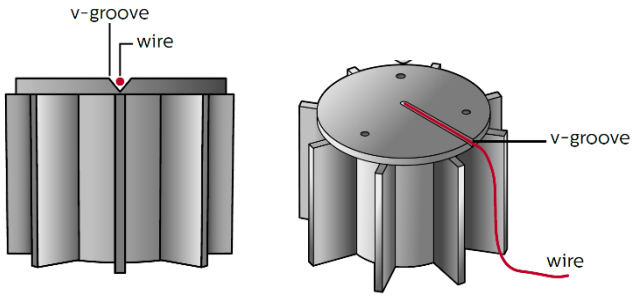




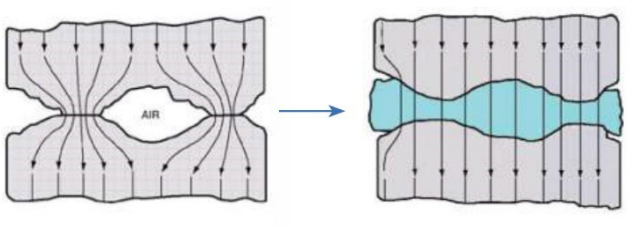
Thermocouple wire fed through provision in holder

Tc-nominal and Tc-max

With the introduction of Fortimo LED SLM the luminaire manufacturer is enabled to make their luminaire even more compact due to a smaller heat sink. For this, Tc-max has been introduced. The Tc-max value for the Fortimo LED SLM is set to 95 °C and it is the maximum temperature at which the Philips Fortimo LED SLM modules can be operated. Please contact your Signify representative for detailed product specs in that case. At Tc-nominal of 85 °C (only in combination with a current setting within the Warranty Window) all the specifications mentioned in the Fortimo LED SLM commercial leaflet, datasheets and design-in guide are valid and a 5-year system warranty is applicable in combination with a Philips Xitanium LED driver.



Thin v-groove in the heat sink to embed a thermocouple



The working principle of thermal interface material (TIM)

Warning:

The Fortimo LED SLM does not incorporate the NTC feature of the Fortimo LED SLM Gen3 when connected to a Xitanium LED driver. Special care needs to be taken for active cooled solutions. Please ensure that your operating current is within limits for the CoB.

Note:
With no Rset connected to the driver/current set via DALI or SimpleSet the driver goes to its default current (specified in the driver datasheet). This default current must also be less than the maximum current specified for the module.

How to measure the critical temperature point Tc

The Tc temperature can be measured by making a thin v-groove or a small drill hole in the heat sink to reach the bottom of the LED module. Be sure to measure the temperature of the bottom of the module and not of the thermal interface material (TIM).

Thermal interface material

The function of a thermal interface material is to reduce thermal impedance between the LED module and the heat sink. The thermal interface material replaces air, which is a thermal insulator, by filling the gaps with material that has better thermal conductivity. This is shown diagrammatically in the figure on the left.
In general:
• Thermal paste performs better than thermal pads.
• The lower the thermal impedance the better.
• The thickness of the TIM should relate to the surface roughness and flatness of the used heatsink.
Due to the small footprint of the Fortimo SLM, it is more sensitive to roughness and surface quality of the heat sink counter surface. It is highly recommended to have this surface clean and free of burs before applying the thermal interface material and the SLM module.
A list of complementary partners for thermal interface material products that can be used with the Fortimo LED SLM module can be found at the end of this document. Reference to these products does not necessarily mean they are endorsed by Signify. Signify gives no warranties regarding these products and assumes no legal liability or responsibility for any loss or damage resulting from the use of the information given here.
For the Fortimo LED SLM it is recommended to use a thermal paste or phase change material as Thermal Interface Material (TIM). Please also be aware that an electrically insulating phase change material will introduce a thermal penalty compared to nonelectrically isolating phase change material. Thick thermal interface materials are not recommended.

Complementary thermal solution partners

Thermal solutions do not form part of the Fortimo LED SLM system offering. This is an added-value area for OEMs, offering the possibility to
differentiate. However, there are many thermal solution companies who have a standard portfolio of compatible heat sinks available, enabling quick and easy luminaire creation. A list of complementary partners offering compatible cooling systems for Fortimo LED SLM modules can be found at the end of this document.
Reference to these products does not necessarily mean they are endorsed by Signify. Signify makes no warranties regarding these products and assumes no legal liability or responsibility for any loss or damage resulting from the use of the information given here.

Electrical design-in and flexibility

Connection to the mains supply

The mains supply must be connected to the LED driver (Line and Neutral can be interchanged).

Double Isolated Drivers

The Fortimo LED SLM products are designed to be used with double isolated drivers. This allows for an easier design-in with no isolation required on the luminaire.

Tune the luminaire's flux (lm) and efficacy (lm/W)

The LED SLM specifications are provided under nominal conditions, like nominal flux at nominal current. It is however possible to deviate from this nominal current. By altering the current, we can obtain different flux outputs. At the same time, the required forward voltage (Vf) also changes, leading to a change in the efficacy (lm/W). The following sections explain the impact and boundaries.

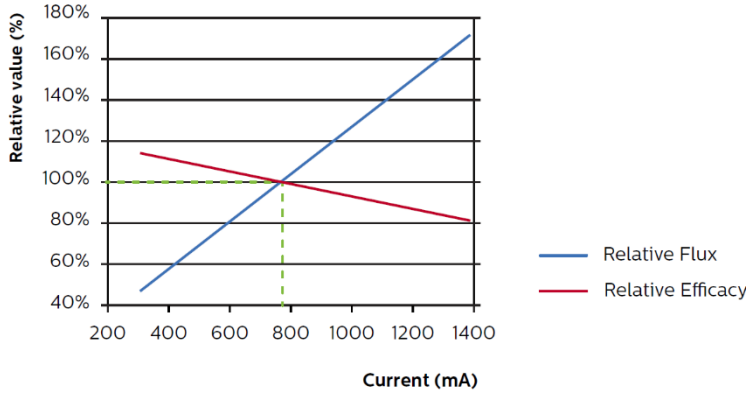
Effect of Choosing a different current value

In case the customer chooses to set the current (either by programming or by applying an Rset resistor) other than nominal, the lifetime and reliability of the LED SLM must be considered. The following current regions can be distinguished:

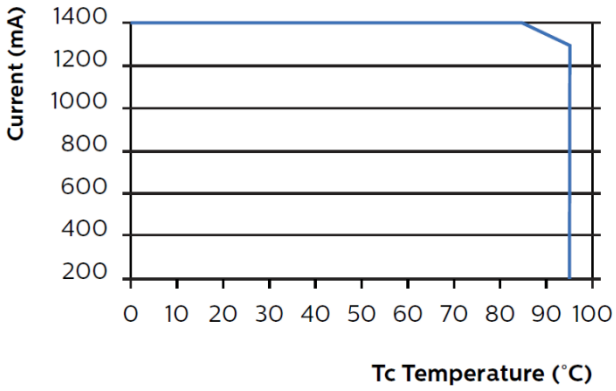
1. Current < nominal current* (mA)
   a. Efficacy (lm/W) higher than nominal value lumen output (lm) lower than nominal value
   b. Lifetime > 50,000 hours
2. Current between nominal current and absolute maximum current** (mA).
   Your warranty may be affected in this case.
   a. Efficacy (lm/W) lower than nominal value lumen - output (lm) higher than nominal value
   b. Lifetime may be < 50,000 hours
3. Current > absolute maximum current: do not exceed the absolute maximum current as this can lead your LED SLM module to failure. No warranty applicable in this case.

Note:
You must check if your chosen operating point falls within the warranty window stated in the datasheets along with the flux tuning graphs as shown on the left. The warranty is applicable for the Philips Fortimo LED SLM modules for 1 switching cycle per day in combination with a SELV driver.

The rated average life is based on engineering data testing and probability analysis. The hours are at the L70B50 point.
* Nominal current at which performance and lifetime is specified
** Maximum current tested for safety



Example graph showing flux and efficacy as a function of current



Example warranty window

Poke-in Rset inserted in a driver

Warning:

Please note that changing the rset on the module changes the current and voltage at which the module operates. You may have to adapt your design accordingly. In case no Rset is used, please check the default setting of your driver. This current may be higher than what your CoB can handle!

Set the output current via Rset

By making use of a resistor component with a determined Ohmic value you can set the required current for your LED module. This component can be a leaded standard 1% tolerance resistor of e.g. 0.125 W or 0.25 W, 50 V. The Rset will not be part of the electrical chain driving the module. An example of a resistor placed into the drivers' input is shown below.

Three different Rset resistors are utilized in the Xitanium Indoor Spot and Downlight LED driver portfolio:

Rset1 (older drivers)*; allows output current setting up to 700 mA
Rset2; allows output current setting up to 2000 mA
LEDset: Allows output current setting up to 8000 mA

In all documentation, Rset may refer to either Rset1, Rset2 or LEDset, depending on the driver type. Please check the driver datasheet for which Rset the driver you use reads. You can find this at www.philips.com/oem.

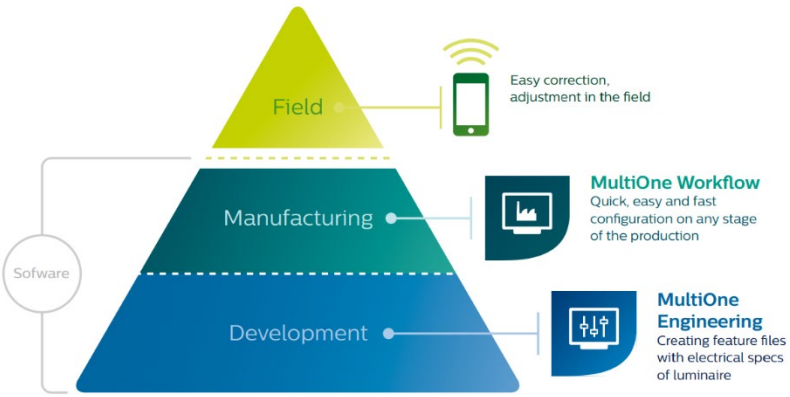
Notes:

- The Rset must be inserted such that there is no mechanical pressure on it from the driver casing being closed.
- Rset1 and Rset2 use different pins on the driver. The Rset1 and Rset2 values with the corresponding drive currents are shown in the DIG for drivers and in the Easy Design-in Tool at www.easydesignintool.com.
- It is advised to select the nearest lower resistor value that is available to you, if the exact determined value is not at hand.
- Nowadays, drivers with dip switches to set the current are available as well.

Programming the output current

The Xitanium TD drivers offer a full range of controls, enabling customizable luminaire design and performance. It is possible to control light output levels, preset dimming protocols, and set system specifications in the factory, and even in the complete installations. This can be done with the Philips MultiOne configurator.

Structure of the MultiOne configurator tool



The MultiOne configurator is an intuitive tool that unlocks the full potential of all programmable Philips drivers, ensuring that the driver performance matches the needs of the lighting solution. It offers unprecedented flexibility, before, during, and after the product installation.

With the latest selected drivers, SimpleSet® functionality is also supported via MultiOne.

Please, check the datasheet of the driver on www.philips.com/oem to know if your driver supports SimpleSet® or not. For more information on Multi-One visit: www.philips.com/multiOne This site contains detailed information on how to install the software and how to program the driver.

Xitanium Indoor Spot and Downlight LED drivers

For the drivers, the same documentation philosophy holds as for the LED modules, meaning that also three documents make up the full information set of the drivers. For detailed info, please refer to these documents for your driver on www.Philips.com/Technology.

Compatible Drivers with SLM

A list of compatible drivers, specific to your choice of module and operating point can be obtained from the Easy Design-in Tool that can be found at www.easydesignintool.com. In case of queries, please contact your Signify representative.

More CoB’s on one driver

CoB’s in series

CoB’s can be connected in series. However, carefully check the voltage rating of the holder.
The maximum output voltage of the driver must not exceed the voltage rating of the holder.

CoB’s in parallel

Parallel operation of CoB’s is technically possible but has the risk of current unbalance. Since the CoB’s will differ in Vf, the current will not be evenly distributed over the CoB’s. As a result, the light output between the different CoB’s connected in parallel, may differ. We therefore do not support it. Customers can apply this solution at their own risk.

Reliability

Lumen maintenance

L70B50 @ 50,000 hours

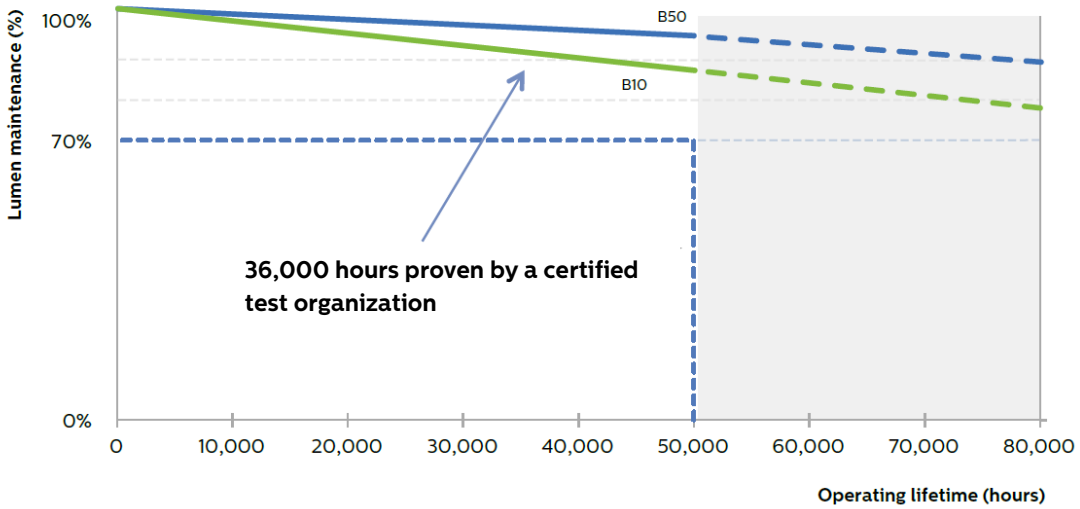
The quality of the LED SLM portfolio is backed by the claim of B50L70 @ 50,000 hours. This means that at 50,000 hours of operation at least 50% of the LEDs' population will emit at least 70% of its original flux . This is contrary to conventional light sources, where some time after Service Life Hours the conventional light source emits no light at all.

In this section the example graphs show the estimated lumen depreciation curves for different percentage of the population and at nominal Tc temperatures. The actual data for the LED SLM modules can be found in the associated datasheet at www.philips.com/oem.

Average rated life is based on engineering data testing and probability analysis. The Fortimo LED SLM modules are specified to reach L70B50 for the nominal specifications.

Lumen maintenance for B10 and B50

The example graph shows the lumen maintenance (% of initial flux over time) for B50 (50% of the population) and B10 (90% of the population).



Example lumen maintenance as a function of operating hours for B10 and B50 at Tc nominal

In our datasheets we use lumen maintenance tables

Lumen maintenance

Operation point	Lumen maintenance	L70			L80			L90		
	x 1000 hours	B50	B20	B10	B50	B20	B10	B50	B20	B10
80% I-nom 576 mA	Tc 75°C	>66	>66	>66	>66	>66	>66	>66	>66	>66
	Tc 85°C	>66	>66	>66	>66	>66	>66	>66	>66	>66
	Tc 95°C	>66	>66	>66	>66	>66	>66	>66	>66	>66
I-nom 720 mA	Tc 75°C	>66	>66	>66	>66	>66	>66	>66	>66	>66
	Tc 85°C	>66	>66	>66	>66	>66	>66	>66	>66	>66
	Tc 95°C	>66	>66	>66	>66	>66	>66	>66	>66	64
I-max 1840 mA	Tc 75°C	>66	60	55	44	37	34	21	17	16
	Tc 85°C	60	51	46	37	32	29	17	15	13
	Tc 95°C	52	43	40	32	27	25	15	12	11

Example of a lumen maintenance table from a datasheet

Controllability

Dimming

The Philips Fortimo LED Linear systems are complemented with a range of Xitanium drivers. These drivers are available as:

- Non-dimmable (Fixed Output) drivers
- Dimmable drivers based on TouchDim & DALI protocol (TD)
- Trailing Edge dimmable drivers (TE)

Please refer to the Xitanium Indoor Linear LED driver Design-In Guide in the download section on www.philips.com/oem for detailed information.

MasterConnect Systems (MC)

MasterConnect is our brand name for wireless connected systems. These systems allow you to create systems with wireless control, ranging from very simple, local systems to large systems that can be integrated into Building Management Systems.

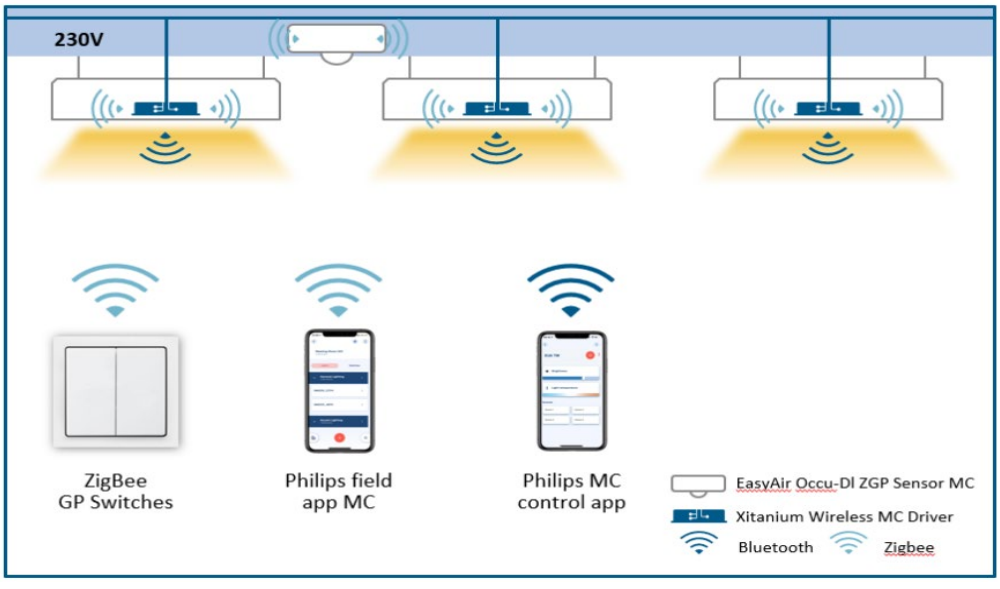
Visit www.philips.com/oem to find out more about our entire portfolio of control products. Design in Guides are available there as well.

EasyAir Occ ZGP sensor MC

EasyAir Occu-DL ZGP sensor MC

Xitanium Wireless mini MC driver

Xitanium Wireless track MC driver



MasterConnect Architecture

Complementary partners

Complementary reflector partners	
Jordan	www.jordan-reflectoren.de
NATA	www.nata.cn
LEDIL	www.ledil.com
Almeco	www.almecogroup.com
BJB	www.bjb.com

Complementary lens partners	
BJB	www.bjb.com
LEDIL	www.ledil.com
Carclo	http://www.carclo-optics.com/
Darkoo Optics	www.darkoo.cc
CK Optics	www.ckoptics.com

Thermal interface partners	
Laird Technologies	www.lairdtech.com
The Bergquist Company	www.bergquistcompany.com

Complementary heat sink partners	
Sunon	www.sunon.com
AVC	www.avc.com.tw
Wisefull	www.wisefull.com
MechaTronix	www.mechatronix-asia.com

Compliance and Approval

Compliance and approbation

The modules bear the CE mark indicating that they comply with the appropriate European EU directives. SLM modules will also be ENEC+ certified (except with the combination of the poke-in holder). The relevant standards are summarized below. To ensure luminaire approval, the conditions of acceptance need to be fulfilled. Details can be requested from your local sales representative. All luminaire manufacturers are advised to conform to the international (luminaire standards IEC 60598-1) and national standards of luminaire design.

IP rating, humidity and condensation

The Fortimo LED SLM modules are build-in modules relying on the luminaire for environmental protection. They have no IP classification. They are not designed for operation in an unprotected open-air environment. Fortimo LED SLM modules are not suitable for direct exposure to moisture, dust, chemicals, salt, etc. The Fortimo LED SLM module has been developed and released for use in dry or damp locations. If there is a possibility that condensation could come into contact with the modules, the system/luminaire builder must take precautions to prevent this. The OEM is responsible for proper IP classification and approval of the luminaire.

Electrostatic discharge (ESD)

Introduction to ESD

It is generally recognized that ElectroStatic Discharge (ESD) can damage electronic components, like LED chips, resulting in early failures. Professional users of electronic components are used to implement extensive and disciplined measures to avoid ESD damage in their finished end products. Now, with the introduction of LED electronic components for lighting a new breed of users, such as OEMs and installers, are exposed to handling and manufacturing with LED electronic components.

ESD requirement links to product specification

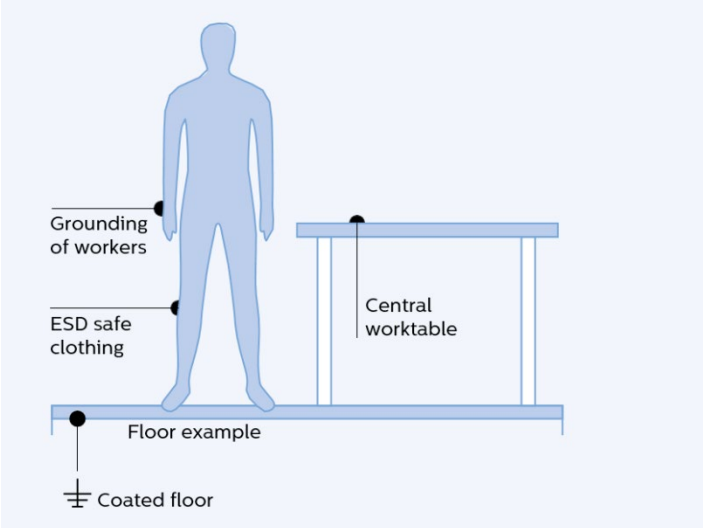
Philips designed its LED Linear products rather robust against ESD. In our LED-packages, a Zener Diode (or TVS) is used to protect the LED-chip. Note that some Certaflux modules are not protected with a TVS. For these products, the guidelines in this section are even more relevant. Specifications of the LED Linear module's maximum contact discharge level and air discharge level, according to IEC 61000-4-2 (150pF/330Ω), are stated in the associated datasheets of the LED module you use, on: www.philips.com/oem.

ow to... Meet the ESD requirement

Advice is to make use of ESD consultancy to determine how the ESD requirement can be met. One should think of an ESD control plan and ESD adequate equipment. Independent ESD consultancy companies can advise and supply adequate tools and protection guidance. For example Philips Innovation Services can provide that consultancy. More information can be found in the section entitled 'Contact details'.

Servicing and installing luminaires

It is highly recommended that Installers are informed that they should not touch the LED components and should use earthed arm-straps to avoid ESD damage during installation and maintenance.



Switching cycles versus case temperature

The Fortimo LED SLM module lifetime expectancy can be affected by thermal cycling. Thermal cycling can cause wire bonding fatigue if the thermal rise of the module increases too quickly in a given period of time. Continuously cycling with this condition will cause shortened product life. Specific cycling versus module case temperature information for the Fortimo LED SLM modules can be found in the product datasheet.

Environmental compliance

The photobiological safety standard IEC 62471 ('Photobiological safety of lamps and lamp systems') gives guidance on how to evaluate the photobiological safety of lamps and lamp systems including luminaires. This standard specifies the exposure limits, reference measurement technique and classification scheme for the evaluation and control of photo-biological hazards from all electrically powered incoherent broadband sources of optical radiation including LEDs in the wavelength range from 200 nm through 3000 nm. Measured results of emission limits for Fortimo LED SLM modules using the non-GLS (20 cm) method are listed in the datasheets that can be found at www.philips.com/oem.

Blue Light Hazard

From the nature of most LEDs applying blue light, emphasis has been put on the hazard in terms of Photo Biological Safety (PBS). Evaluation by the European lighting industry (ELC, Celma) has concluded LED light sources are safe for customers when used as intended. A photobiological safety report is available at www.philips.com/oem. Nevertheless, luminaire makers must comply with luminaire standards including PBS. To avoid extensive retesting, it is preferred to build on the test conclusions of the LED (module) suppliers. However, this should be discussed and agreed upon with the used certification body. The testing conclusion then will be expressed in Risk Groups (RG), where RG0 and RG1 are considered safe and/or do not require specific action for the luminaire makers (as compared to RG2 and 3).

CrispWhite Technology

Fortimo LED SLM CrispWhite modules provide the user with intense whites and rich colors. Please note that the product has no UV wavelengths being emitted. Several materials have been tested in combination with the crisp white light and the results are promising. When tested with PMMA, PC reflectors and silicone reflectors, under different temperature and light conditions, no photo-ageing effect from the deep blue flux is observed. If more information is needed, please contact your Signify representative.

Chemical Compatibility

The CoB contains a silicone overcoat to protect the LED chip and extract the maximum amount of light. As with most silicones used in LED optics, care must be taken to prevent any incompatible chemicals from directly or indirectly reacting with the silicone. The silicone overcoat used in the CoB is gas sensitive. Consequently, oxygen and volatile organic compound (VOC) gas molecules can diffuse into it. VOCs may originate from adhesives, solder fluxes, conformal coating materials, potting materials and even some of the inks that are used to print the PCBs.

When used in industry, heavy traffic and outdoor environments, the LED module must be properly shielded from ingress of sulfur and chlorines. The usage of IP enclosed luminaire solutions does not eliminate the risk of ingress of these corrosive gasses. Proper testing is required to validate LED luminaire designs. In addition, the components used in the luminaire should be clean from corrosive VOCs. A chemical compatibility check needs to be performed for the industrial environment and the components used in the luminaire. Please consult us if you wish to deviate from the design rules described in this guide.

A list of commonly used chemicals, that should be avoided as they may react with the silicone material, is provided below. Note that Signify does not warrant that this list is exhaustive since it is impossible to determine all chemicals that may affect LED performance. These chemicals may not be directly used in the final products but some of them may be used in intermediate manufacturing steps (e.g. cleaning agents). Consequently, trace amounts of these chemicals may remain on (sub) components, such as heat sinks. It is recommended to take precautions when designing your application.

Chemical Name	Type
Hydrochloric acid	acid
Sulfuric acid	acid
Nitric acid	acid
Acetic acid	acid
Sodium Hydroxide	alkali
Potassium Hydroxide	alkali
Ammonia	alkali
MEK (Methyl Ethyl Ketone)	solvent
MIBK (Methyl Isobutyl Ketone)	solvent
Toluene	solvent
Xylene	solvent
Benzene	solvent
Gasoline	solvent
Mineral spirits	solvent
Dichloromethane	solvent
Tetrachloromethane	solvent
Castor oil	oil
Lard	oil
Linseed oil	oil
Petroleum	oil
Silicone oil	oil
Halogenated hydrocarbons (containing F, Cl, Br elements)	misc
Rosin flux	solder flux
Acrylic Tape	adhesive

Storage and Transport Conditions

- Store in a dark place. Do not expose to sunlight.
- Maintain temperature between -40 +80 °C, and RH 5 – 85%.

Liability

Signify shall not be held responsible or liable for any damage, costs or expenses to the user, resulting from an accident or any other cause during operation if the system is used without due observance of the absolute maximum ratings and other instructions provided by Signify.
Warranty is applicable for the Philips Fortimo LED SLM modules for 1 switching cycle per day, in combination with a SELV driver.

Contact details

Signify
www.philips.com/oem

Or contact your local Signify sales representative.

Disclaimer

Signify will perform the testing of the LED systems to high standards of workmanship. The tests are carried out with reference to the EN/IEC standards, if any, which are regarded by Signify as being of major importance for the application of the lamp gear and the lamp within the fixture.

The design-in guide, regarding the testing and design in of the LED system provided by Signify, is not an official testing certificate, and cannot be regarded as a document for official release of the fixture. The OEM is liable for the official testing by a certified test body and all markings, such as CE and ENEC marks, on the fixture assembly.

The design-in guide is for information purposes only and may contain recommendations for detecting weak points in the design of the system (lamp – lamp gear – fixture), if any.

Specifically mentioned materials and/or tools from third parties are only indicative: other equivalent equipment may be used but it is recommended that you contact Signify for verification.

Signify will not be liable for unforeseen interactions of the proposed solutions when applied in the fixtures or applications using these fixtures. Signify has not investigated whether the recommendations are or will in the future be in conflict with existing patents or any other intellectual property right. Signify does not warrant that its recommendations are technically or commercially the best options.

Since the tests are only performed on one particular fixture provided by the customer, it will be treated as a prototype. This means that there is no statistical evidence regarding later production quality and performance of the lamp – lamp gear – fixture system.

As Signify does not have control over manufacturing of the fixtures, Signify cannot be held liable for the fixture assembly.

Signify will not accept claims for any damage caused by implementing the recommendations.

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The OEM must bring any claim for damages within ninety (90) days of the day of the event giving rise to any such claim, and all lawsuits relative to any such claim.

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