PHILIPS

LED Modules

Design-in Guide

Fortimo SLM Gen 6

Excellent color quality and flexibility

Contents

General introduction

Figure 1. Philips Fortimo LED SLM gen 6 module.

Thank you for choosing the Philips Fortimo LED spotlight module (SLM) gen 6. In this guide you will find the information required to design this module into a luminaire.

Information and support

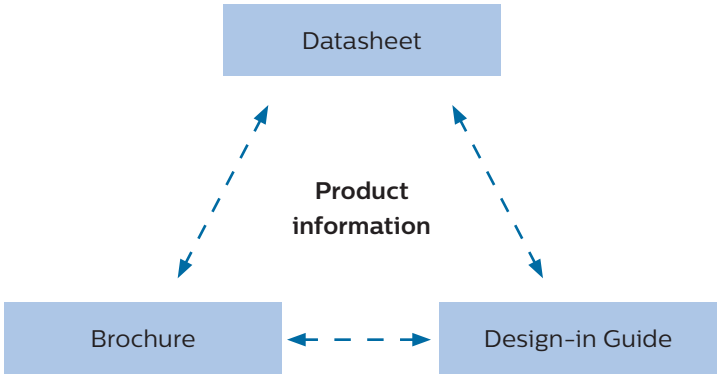
If you require any further information or support, please consult your local Philips sales representative or visit our website: www.philips.com/ledmodulesna.

Determine which documents contain what information

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

- **Brochure** contains product family information and system combinations (compatible Philips Advance LED drivers and Rsets)
- **Datasheet** contains the module (CoB and holder) specification
- **Design-in guide** describes how to design-in the products

All these documents can be found at www.philips.com/ledmodulesna. If you require any further information or support please consult your local Philips representative.



Warnings and instructions

When using a driver intended for these modules:

Please note

- The Philips Fortimo LED SLM gen 6 modules must be operated with UL Class 2 drivers with the exception of the CRI 70 range, which could also be used with UL non-Class 2 drivers. Please contact your local sales representative for more information or visit our online Easy Design-in Tool (https://www.na.easydesignintool.philips.com) for the latest compatible system drivers.
- Avoid touching the light emitting surface!

Design-in phase

- Do not apply mains power to the module (Fortimo LED SLM gen 6 CoB and holder) directly.
- Connect the modules and drivers before switching on mains.
- The Fortimo LED SLM module does not contain a fuse that protects individual LEDs against high currents. In the event of failure, there is the need to take the following precautions in the luminaire system design in order to protect the system against any potentially unsafe conditions due to increased temperature. The Fortimo LED SLM module should not be designed into an unprotected open luminaire system. Philips strongly recommends that all open luminaire systems incorporate a fuse to protect against high currents in the event of an individual LED module failure. A minimum safe distance should be maintained between an individual LED module and any flammable materials (e.g., diffusor). If any materials are designed to be in direct contact with an individual LED module, the OEM should ensure that the material has an appropriate flammability rating in accordance with safety agency regulations. Philips recommends the use of materials with a flammability rating of V1 or V0 in case the material is closer than 13mm to the LED. Failure to follow these recommendations may potentially cause an unsafe thermal condition to exist.
- Provide adequate environmental protection.
- Due to the increased Tcase nominal temperature of the module to 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.
- Avoid contamination (direct or indirect) from any incompatible chemicals reacting with the silicone. Table 11 shows a list of incompatible chemicals for compliance and approval.

Manufacturing phase

- Do not use products if the phosphor on the CoB is discolored/scratched or if the holder is broken.
- Do not drop the Fortimo LED SLM module or damage in any way.
- Connect the modules and drivers before switching on mains.
- Avoid contamination (direct or indirect) from any incompatible chemicals reacting with the silicone. Table 11 shows a list of incompatible chemicals for compliance and approval.

Installation and service for luminaires incorporating the Fortimo LED SLM system

- Do not service the luminaire when the mains voltage is connected; this includes connecting or disconnecting the Fortimo LED SLM holder from the driver.

Philips design-in support is available; please contact your Philips sales representative.

Introducing the Philips Fortimo LED SLM gen 6 system

Figure 2. Philips Fortimo LED SLM gen 6 modules and 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 downlighting applications. It is consistent with other Fortimo families of modules, delivering a high quality of light and peace of mind.

Module types

The Fortimo SLM gen 6 module comprises of a range of CoBs that can be paired with the following holders:

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

The user can choose to operate any of these modules at different currents to obtain a required lumen output.

With the Fortimo SLM gen 6, the user has the flexibility to choose among a wide range of CoBs and pair it with any of the available holders. Each CoB can be tuned as needed in order to achieve a high lm/W or a high lm/$. This flexibility provides the user with a full portfolio comprising of a wide range of products.

Note:
The system warranty[1] is only valid when Philips components are used for the complete system (LED module, holder and driver).

Identifying 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. The following is a description of the identification on the CoB:

YYZZ X 12WW

YYZZ : Color (3080: 3000K, CRI 80; 4090: 4000K, CRI 90 and so on)

X : Special color (P: premium white, C: crisp white)

WW : CoB type (1202, 1203, 1204, 1205, 1208, 1211, 1216)

In this guide you will find the specific information required to develop a luminaire based on the Philips Fortimo LED SLM module. Product specific data can be found in the associated datasheet on www.philips.com/ledmodulesna.

1. View limited warranty at http://www.usa.lighting.philips.com/support/support/warranty for details and restrictions.

Figure 3. Philips Fortimo LED SLM gen 6 module.

Choosing the correct Fortimo LED SLM module

The Fortimo LED 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 a number of different operating points to suit your needs.

Naming of the Fortimo LED spotlight modules

The names of the modules are defined as shown in the example below:

CoB

Fortimo SLM C 830 XX 1208 L15 2024 G6

Fortimo	: Our brand name for high-quality, efficient, smart, future-proof and reliable LED lighting
SLM	: Spotlight module
C	: CoB
830	: For a color rendering index >80; 30 stands for a CCT of 3000 K

XX	**This stands for the following names:**
CW	: Crisp white
FWW	: Food warm white
FPR	: Food premium red
PW	: Premium white
1208	: CoB type
L15	: LES (Light Emitting Surface) has a diameter of 15 mm
2024	: Holder dimensions, can be matched with the naming of the holder
G6	: Indicates the generation gen 6

Holder

Fortimo SLM H YY 2024 G1

Fortimo	: Our brand name for high-quality, efficient, smart, future-proof and reliable LED lighting
SLM	: Spotlight module
H	: Holder

YY	**This stands for the following names:**
-	: Standard version
DL	: Downlight version
PI	: Poke-in version
ZP	: Zhaga poke-in version
2024	: Holder dimensions, can be matched with the naming of the CoB
G1	: Indicates the generation 1

Emergency application

Figure 4. Philips Bodine BSL17C-C2 emergency LED driver.

In general commercial and government buildings in the U.S. require emergency lighting in order to meet the Life Safety Code® NFPA 101®. Philips Emergency Lighting offers the BSL17C-C2 emergency LED driver specifically designed for the Fortimo SLM gen 6. When AC power is lost, the BSL17C-C2 takes over operation of the LED module for 90 minutes to help comply with emergency code requirements. The BSL17C-C2 is Class 2, UL Component Recognized and CSA Certified. Please check the emergency driver datasheet for the latest wiring diagram.

For more information, please visit the Philips Emergency Lighting website at www.bodine.com/products/specs/bsl17cc2.html. Emergency product training videos can be found online (www.youtube.com/user/PhilipsBodine). To go directly to this spec sheet, use http://www.bodine.com/downloads/specs/BSL17-C2_17C-C2.spec.L2300223.pdf.

Zhaga*

Figure 5. Measurements showing compliancy to Zhaga book 3 Version 1.2 have been done on the 3000lm L15 module.
Philips Fortimo LED SLM gen 4 and gen 5 modules are Zhaga certified light engines. Philips Fortimo LED SLM gen 6 modules are Zhaga compatible. Visit www.zhagastandard.org for more information.

Zhaga is a global consortium from across the lighting industry. The overriding aim is to bring standardization to applications in general lighting by creating well defined interface specifications. This ensures the interchangeability of LED light sources from different manufacturers. The Fortimo LED SLM gen 6 modules are Zhaga compatible.

For more information on Zhaga, please refer to the website:
http://www.zhagastandard.org/.

Assembling your Fortimo LED SLM module

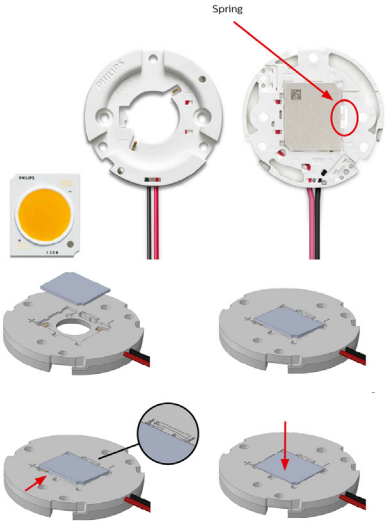


Figure 6. Assembling your Fortimo LED SLM module.
Step 1: Align the + and - of the CoB and holder.
Step 2: Place the CoB against the spring at an angle.
Step 3: Compress the spring with the CoB.
Step 4: Click the CoB down into the holder.

The Fortimo LED SLM module is delivered to you as a combination of the CoB and holder. 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 left explain this process step by step.

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, there may be no contact with the heat sink once inserted into the holder. When clamps are screwed down, the CoB will have a good thermal down force. It is a metal, mechanically closed system so there will be no plastic creepage.

Fortimo LED SLM module use in outdoor applications

Neither the Fortimo LED SLM module nor the associated indoor point LED driver has an IP classification. If these products are used in luminaires for outdoor applications, it is up to the OEM to ensure proper protection of the luminaire. A suitable IP rated enclosure must be used for outdoor applications that use the Fortimo LED SLM module and associated LED driver. It is the responsibility of the OEM to select a suitable luminaire that will allow for proper classification and approbation. Please consult your Philips sales representative if you wish to deviate from the design rules described in this guide.

*Measurements showing compliancy to Zhaga book 3 Version 1.2 have been done on the 3000lm L15 module.

In this design-in guide

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

The range consists of a wide selection of of chip-on-board (CoB) products:

- Standard versions in various lumen packages and colors; on the black body line.
- Premium white in various lumen packages and colors; below the black body line providing an improved white perception.
- SLM crisp white: An optimized spectrum for retail, providing intense whites and rich colors.
- SLM food warm white: A specific spectrum for enhancing the appearance of fresh food.
- SLM food premium red: A specific spectrum for enhancing the appearance of fresh meat.

The initial purpose of this product is for retail lighting applications, more specifically for food, furniture and leather, for example. The product is not intended for use in other applications.

Figure 7. Philips Fortimo LED SLM gen 6 module.

Each of these CoBs can be paired with any of our available holders (standard: with fitted pre-tinned cables; downlight: with fitted pre-tinned cables with a 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 Philips Advance Xitanium LED drivers, the user has the possibility to drive their module at different currents in order to achieve a high lm/W or a high lm/$ at different lumen outputs.

Holders for Fortimo SLM gen 6

The Fortimo SLM gen 6 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 (60 cm)
Each CoB can be bought in combination with this holder. The length of the cable is by default 60cm, but the customer can cut it to the appropriate length if needed.

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.

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 from www.philips.com/ledmodulesna.

4. Zhaga poke-in holder

With gen 6, a new holder is introduced into the Philips Fortimo SLM portfolio. 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. A number of features can vary between all holders. It is important to read this guide in order to understand this. 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 pressed against 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 compatible screw holes	Only the Zhaga screwholes are available	Screw holes same as the standard version
Provision to feed through a thermocouple wire to use the T sense point	No such provision	Provision to feed through a thermocouple wire to use the 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 an impact on the flux output. Please refer to the table below for more information.

	Flux Output			
CoB Type	Bare CoB	Standard/Downlight Holder	Poke-in Holder	Zhaga Poke-in 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%	99.80%
1216	100.00%		99.90%	
Average:	100.00%	98.60%	99.30%	99.20%

The Philips Fortimo SLM C warranty is invalidated if any other holder is used other than the designated Philips Fortimo holders.

The Philips Fortimo SLM holders are intended for indoor use. When used in outdoor or semi-outdoor applications adequate protection against UV and the outdoor environment is required. Please contact your local Philips sales representative for design-in support.

Figure 8. Philips Advance Xitanium system driver for the Fortimo LED SLM C gen 6.

Philips Advance Xitanium LED drivers for Fortimo LED SLM gen 6

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 Philips Advance Xitanium drivers for Fortimo LED SLM gen 6 modules can be found in the Xitanium indoor, downlight and spotlight driver design-in guide. These documents can be downloaded via www.philips.com/leddrivers.

The Xitanium driver datasheets can also be downloaded on this website. Full system overviews can be obtained using the Easy Design-in Tool at https://www.na.easydesignintool.philips.com/.

Optical design-in

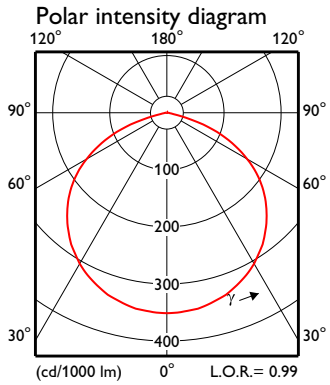


Figure 9. Light distribution diagram.

Light distribution

The Fortimo LED SLM gen 6 generates a Lambertian beam shape (see Figure 9). The secondary optics design should not cover the exit aperture. The IES (or .ldt) files are available via the website, www.philips.com/ledmodulesna.

Reflector design limits

The graphs below (Figure 10 and Figure 11) 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 gen 6 modules.

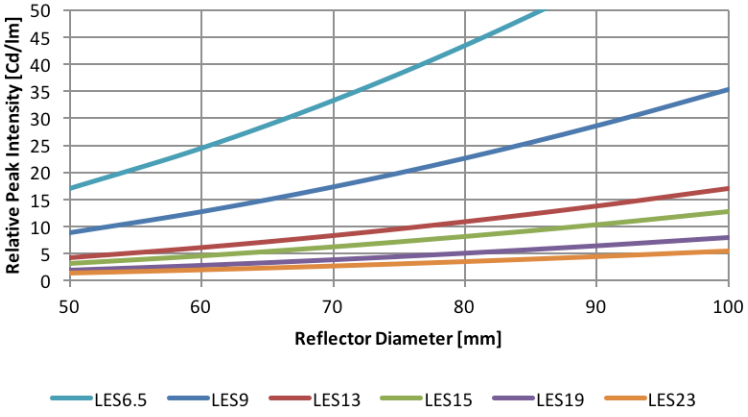


Figure 10. Peak intensities.

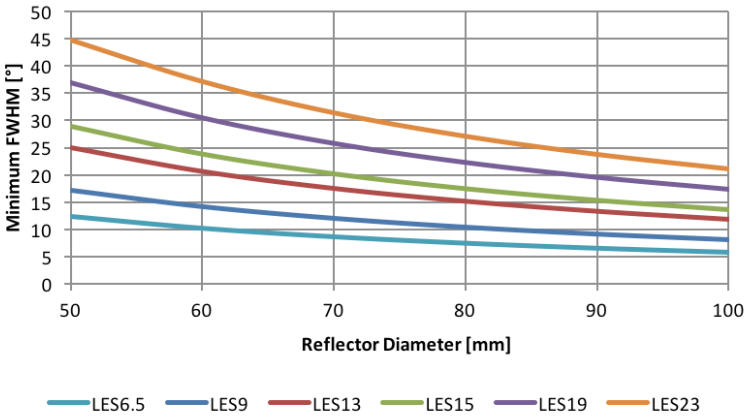


Figure 11. Minimum beam angles.

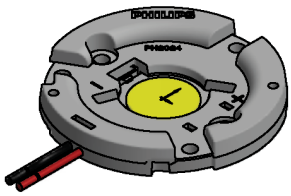


Figure 12. Fortimo SLM gen 6 ray set origin.

Ray sets

The following ray set files are available for customer use and can be downloaded from www.philips.com/ledmodulesna. 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

Table 1. Ray set files

The origin of the ray sets is shown in Figure 12, 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 (2mm 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 CCTs, CRIs 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 gen 6 modules is 3 SDCM. This results in an excellent color consistency performance.

Color targets

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

Spectral light distribution

The typical spectral light distributions of the Fortimo LED SLM gen 6 colors are shown in the respective datasheets on www.philips.com/ledmodulesna.

Starting characteristics

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

Complementary reflector partners

Secondary optics is not part of the Fortimo LED SLM system offering. However, there are many reflector companies that have a standard portfolio of compatible reflectors available, enabling fast time to market. Table 2 gives a list of complementary partners offering compatible reflectors for Fortimo LED spotlight modules.

The following are examples of reflector products that can be used with the Fortimo LED SLM system. Reference to these products does not necessarily mean they are endorsed by Philips. Philips 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.

Complementary Reflector Partners
Jordan (www.jordan-reflektoren.de)
NATA (www.nata.cn)
Widegerm (www.widegerm.com.hk)
LEDIL (www.ledil.com)
Almeco (www.almecogroup.com)

Table 2. Complementary reflector partners

Mechanical design-in

Fortimo LED SLM gen 6 module dimensions

The Fortimo LED SLM gen 6 modules comply with the Zhaga* book 3 for LED accent lighting modules. 3D CAD files can be downloaded from our website www.philips.com/ledmodulesna. Basic dimensions for each module can also be found in the datasheets, which are also available at mentioned website.

Recommended torque

M3 screws are used for mechanical fixation of the Fortimo LED SLM module with an associated holder to the heat sink. The recommended torque for mechanical fixation is 0.6 Nm (assuming pre-taped holes are present in the heat sink).

Fortimo LED SLM CoB mounting torque without holder (directly mounted to the heat sink)

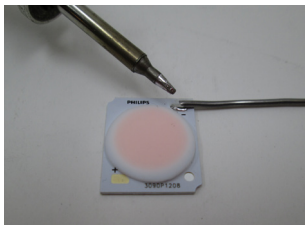
M2 or M3 screws are used for mechanical fixation of Fortimo LED SLM module directly to the heat sink. The recommended torque for mechanical fixation is 0.226 Nm (assuming pre-taped holes are present in the heat sink). A process for mounting a Fortimo LED CoB directly to the heat sink is outlined below.

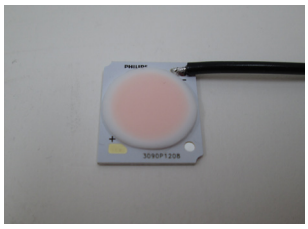
Mounting Fortimo LED CoB directly to a heat sink

Follow these steps to mount a Fortimo LED CoB emitter directly onto a heat sink:

1. Prepare the heat sink.
    a. 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 Fortimo LED CoB emitter and the heat sink.
    b. Drill and tap two M2 or M3 screw holes according to the hole locations indicated in the appropriate datasheet for the Fortimo LED CoB being used.
    c. Wipe the heat sink surface clean with isopropyl alcohol.
    d. Apply a thermal interface material (TIM) onto the heat sink. For more details regarding suitable TIMs see the section related to TIMs on page 20 of this document.
2. Place the Fortimo LED CoB emitter onto the heat sink and align the screw slots in the substrate with the tapped screw holes in the heat sink.
3. Secure the Fortimo LED CoB emitter to the heat sink with two M2 or M3 screws. The screw down torque should not exceed 0.226 Nm.

*Measurements showing compliancy to Zhaga book 3 Version 1.2 have been done on the 3000lm L15 module.





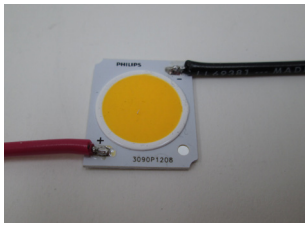


Figure 22. Recommended soldering process.

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.

Please note: 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.

1. Prepare the wires.
- Cut the wires to size.
- Strip a few millimeters of insulating material from the ends of the wires.
- Pre-tin the wires with a small amount of solder.

2. Prepare the pads.
- Clean the pad.
- 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.
- Place the pre-tinned wire on the pad.
- Place the tip of the soldering iron on the pad and allow the solder to reflow around the wire.
- Remove the soldering iron and allow the solder to joint to cool.

Recommendations

1. Preparation
- Wear the wrist strap before operation.
- Do not touch LED during the operation.
- Wire cross-section area should be 0.2...0.75 mm2 (18...24 AWG), solid and fine stranded.

2. Soldering temperature
- Soldering bit temperature shall be 350°C or less.
- 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.
- Do not place the soldering iron on the pad for more than 3 seconds.

3. Appearance condition

- The soldering fillet is formed.
- The core part is soldered well.
- The solder has shiny appearance.
- No sharp protruding point of solder or extreme film building of solder.
- Insulation of wire can't be damaged after soldering.

Please note

It is the responsibility of the customer to control the manual soldering process to ensure a reliable connection is made. (Protruding or loose wires or a cold solder connections, as examples, can cause a short or open condition to exist, resulting in premature luminaire failure.)

Complementary thermal solution partners

Thermal solutions do not form part of the Philips 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 that have a standard portfolio of compatible heat sinks available, enabling quick and easy luminaire creation. Table 5 provides a list of complementary partners offering compatible cooling systems for Fortimo LED SLM modules.

Reference to these products does not necessarily mean they are endorsed by Philips. Philips 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.

Complementary Heat Sink Partners
Sunon (www.sunon.com)
AVC (www.avc.com.tw)
Wisefull (www.wisefull.com)
MechaTronix (www.mechatronix-asia.com)

Table 5. Complementary heat sink partners

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 Philips 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 stabilized, which may take between 0.5 and 2 hours and is defined as at least three readings of light output and electrical power over a period of 30 minutes taken 15 minutes apart with stability less than 0.5%.

Please 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 from 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 13. 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 or critical failures.

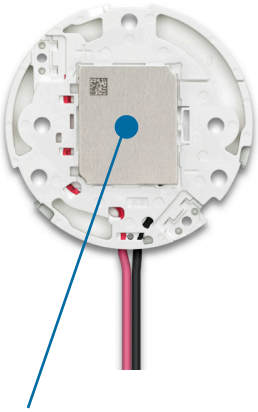


Figure 13. Tc measurement point.

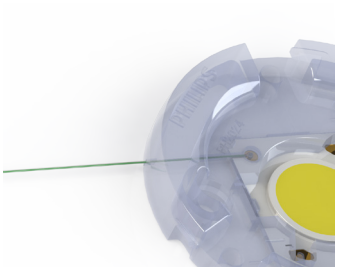


Figure 14A.

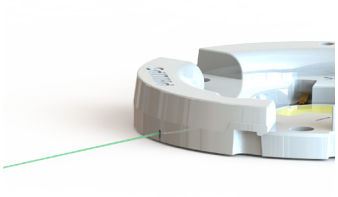


Figure 14B.

Figure 14A and B. Thermocouple wire fed through provision in holder.

To aid easy design-in of the Fortimo LED SLM gen 6, a Tp point is introduced at the top side of the LED module. The Tcase point at the back still remains leading. However, under certain circumstances, the temperature measurements on the Tp 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 to feed through a thin thermocouple wire shown in Figures 14A and 14B. The correlation between the Tp 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 a 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. Results may vary case by case, and it is best if the measurement reference is made at the customer, using the luminaire in question. It is also important to note that the Tcase temperature is always leading. If support is needed, please ask your Philips sales representative about our design-in service.

Tc-nominal and Tc-max

With the introduction of Fortimo LED SLM gen 6, the luminaire manufacturers are enabled to make luminaires 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 gen 6 is set to 95°C, and it is the maximum temperature at which the Philips Fortimo LED SLM gen 6 modules can be operated. Details about specific module types, drive currents and temperatures can be found in the specific datasheets at www.philips.com/ledmodulesna.

At Tc-nominal of 85°C all the specifications mentioned in the Fortimo LED SLM gen 6 datasheets and design-in guide are valid and a 5-year limited system warranty (http://www.usa.lighting.philips.com/support/support/warranty) is applicable in combination with a Philips Advance Xitanium LED driver.

Please note: With no Rset connected to the driver, the driver goes to its default current (specified in the driver datasheet). This default current might exceed the maximum current specified for the module.

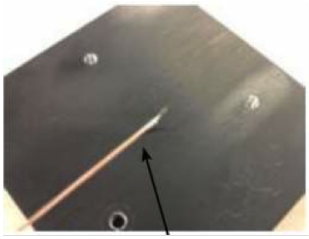


Figure 15. Thin v-groove in the heat sink to embed a thermocouple.

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 Figure 15.

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 heat sink.

Due to the small footprint of the Fortimo SLM gen 6, 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 Fortimo LED SLM module.

In Table 3 are suggestions for thermal interface material product partners to use with the Fortimo LED SLM module. Reference to these products does not necessarily mean they are endorsed by Philips. Philips 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 gen 6 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 non-electrically isolating phase change material. Thick thermal interface materials are not recommended.

Thermal Interface Partners
Laird Technologies (www.lairdtech.com)
The Bergquist Company (www.bergquistcompany.com)

Table 3. Thermal interface partners

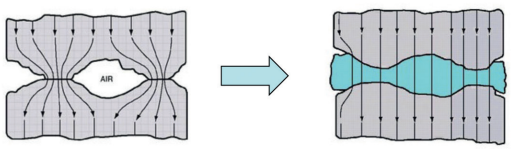


Figure 16. The working principle of thermal interface material (TIM).

Electrical and thermal analogy

Standard static thermal situations can be modeled using "thermal resistances." These resistances behave like electrical resistances. The analogy between electrical and thermal resistances is explained in Figure 17. The electrical units are shown in the figure below, while the thermal equivalents are given on the right in the diagram. With a known voltage difference at a certain current it is possible to calculate the electrical resistance using Ohm's law. The same applies for a thermal resistance. If the temperature difference and the thermal power are known, the thermal resistance can be calculated using the thermal Ohm's law. Please note that using the concept of thermal resistances is a strong simplification of the actual physics of heat transfer to aid in understanding of heat flow and temperature.

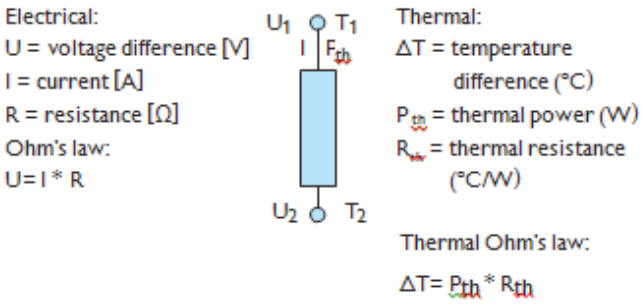


Figure 17. Electrical and thermal analogy.

Thermal model

A thermal model that can be used to determine the required thermal performance of the cooling solution for the LED module is shown in Figure 18.

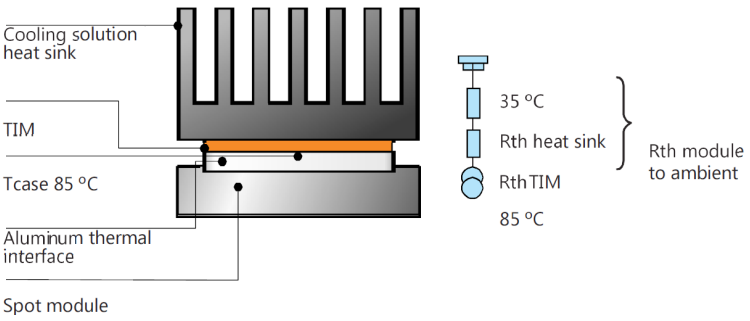


Figure 18. Thermal model.

A simplified model of the thermal path from LED module to ambient; Tc of 85˚C is used as an example.

Thermal design of a heat sink

A successful thermal design-in means that the Tc temperatures of the LED module are within thermal specifications at given maximum operating ambient of the luminaire and the maximum temperature difference between Tc and Tambient should not exceed 60˚C for Fortimo LED SLM gen 6.

Remarks:

- For track spotlighting applications, a minimum of 25˚C design ambient is recommended.
- For recessed spotlighting applications, a minimum of 35˚C design ambient is recommended.

If the expected maximum operating ambient for the luminaire is <25˚C ambient, the luminaire still needs to be tested within thermal specifications of Tcase nominal in a lab environment at 25˚C ambient.

Please note

The maximum temperature difference between Tc and Tambient should not exceed 60˚C for the Fortimo LED SLM gen 6, otherwise it could lead to a reduction in the lifetime of the system.

Warnings

Due to the increased Tcase nominal temperature of the Fortimo LED SLM gen 6 to 85˚C, it is important to take into account the maximum touchable metal surface temperatures of the luminaire during design. With such a high Tcase temperature the maximum temperature for touch safety can easily be exceeded. Failure to do so can result in burnings and other injuries

Fortimo DLM thermal accessory g1

In order to simplify the thermal design, Philips introduces the new Fortimo DLM thermal accessory, which can also be used with Fortimo LED SLM gen 6 and which replaces the requirement of an external heat sink. This option is only applicable for products where thermal power does not exceed 12.4W (T ambient should not exceed 35°C free air flow). Thermal power data can be found at Philips Easy Design-in Tool (https://www.na.easydesignintool.philips.com/). For other products or products driven at higher than typical current, the Fortimo DLM thermal accessory can still be used but as a heat spreader or mechanical interface between the Fortimo LED SLM gen 6 module and an existing/additional heat sink.

Passive and active cooling

In theory two thermal solutions are possible.

Passive cooling

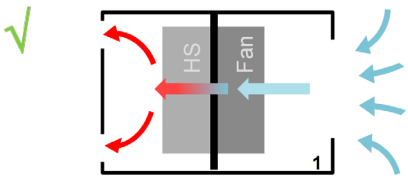


Figure 19. Design guidelines for active cooling solutions.

Passive cooling systems are based on the fact that hot air moves upward, thus creating airflow along the surfaces. This is called natural convection. There are many standard heat sinks available, but it is also possible to design your own heat sink.

In general, a passive cooling solution requires a larger heat sink than an active cooling solution.

Design guidelines for passive cooling

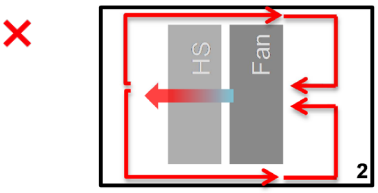


Figure 20. Design guidelines for active cooling solutions.

Before starting to perform any calculations, an important point to consider is the airflow. In general hot air moves upward at a relatively low speed. The shape and position of the heat sink will affect the airflow. Ideally, the fins should be parallel to the direction of airflow. Closure of the top of the profile will reduce the cooling capacity of the heat sink and should, therefore, be avoided during design and installation.

Some additional design guidelines for passive cooling include:

- Limit the number of thermal interfaces in the thermal path from module to ambient.
- Thick fins conduct heat better than thin fins.
- Large spacing between fins is better than small spacing between fins.
- Make cooling surfaces more effective by using proper conductive materials, appropriate thickness and correct fin orientation.
- Thermal radiation plays a significant role => anodized or powder-coated surfaces are preferable to blank surfaces.

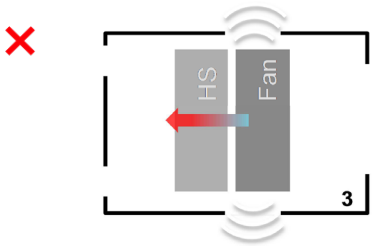


Figure 21. Design guidelines for active cooling solutions.

Active cooling

With this method the air is forced to flow by means of a fan or membrane, which enhances the thermal dissipating capacity of the heat sink. As a result, a smaller heat sink can be used and the orientation of the heat sink has less impact on the thermal performance. A potential side effect is that the fan or membrane might produce noise and consume extra energy.

Furthermore, the specified lifetime of the fan should match that of the application.

Design guidelines for active cooling

Design guidelines for active cooling include:

- The luminaire should be equipped with an inlet for cool air and an outlet for hot air (Figure 19).
- The airflow from the inlet to the outlet should be smooth and without restriction in order to limit vibration, recirculation and noise.
- Recirculation of hot air (Figure 20) inside the luminaire should be prevented, as this will lead to a lower thermal performance and higher noise level.
- Unnecessary openings near the fan in the luminaire housing (Figure 21) should be avoided in order to help contain any noise from the fan.

Electrical design-in and flexibility

Figure 23. 25W Smart Mate driver.

Connection to the mains supply

The mains supply must be connected to the LED driver.

UL Class 2 drivers

The Fortimo LED SLM gen 6 products are designed to be used with UL Class 2 drivers with the exception of use with CRI 70 CoB modules. CRI 70 CoB modules, without the use of holders (directly mounted to the heat sink), were designed with the capability to be used in applications where it is permissible to use non-Class 2 drivers and that the CRI 70 CoB modules could be daisy chained as needed. In the case where the CRI 70 modules are daisy chained, it is necessary to take into consideration the voltage rating of the module as the size of the CRI 70 module (1202 versus 1216, etc.) will impact the amount of modules that can be daisy chained. It is also important to realize that voltage creepage and clearance distances will also vary with the size of the CoB, and this must be considered in the design process. Details about released systems using specific module types and driver combinations can be found using the Philips Easy Design-in Tool (https://www.na.easydesignintool.philips.com/). Please consult your Philips sales representative for further information concerning non-Class 2 Fortimo LED SLM system design.

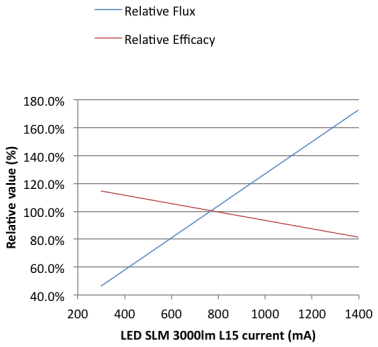


Figure 24. Example graph showing flux and efficacy as a function of current.

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

The Fortimo 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) as shown in Figure 24. 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 applying an Rset resistor or by dip switches) other than nominal, the lifetime and reliability of the Fortimo LED SLM must be taken into account. The following current regions can be distinguished:

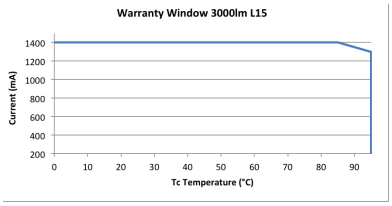


Figure 25. Example warranty window.

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

Please Note: You must check to see if your chosen operating point falls within the warranty window (Figure 25) stated in the datasheets along with the flux tuning graph as shown in Figure 24. The warranty is applicable for the Philips Fortimo LED SLM modules for one switching cycle per day in combination with a UL Class 2 driver.

1 Nominal current at which performance and lifetime is specified.
2 LED lifetime means the length of time (in hours) until half of the LED light sources maintain at least 70% of their initial lumen output (B50,L70).
3 Maximum current tested for safety.

Set the output current via Rset

By making use of a resistor component with a determined Ohm value you can set the required current for your LED module. Use a resistor between Rset2 and SGND terminals. Any through hole or SMD resistor with >0.25W and >20V can be used as RSET between Rset and SGND pins.

Please note that if you have a driver that supports both Rset1 and Rset2, choose Rset2. All future drivers will support Rset2.

Rset Component

12 NC	Material Description	Resistance [Ω]
929000727713	Fortimo LED Rset2 NA 300mA	560
929000727813	Fortimo LED Rset2 NA 500mA	1,200
929000727913	Fortimo LED Rset2 NA 750mA	2,050
929000728013	Fortimo LED Rset2 NA 950mA	3,090
929000728113	Fortimo LED Rset2 NA 1200mA	4,780

Table 6. Rset component

Rset2 Table

Rset2 [Ω]	Iset [mA]	Rset2 [Ω]	Iset [mA]	Rset2 [Ω]	Iset [mA]	Rset2 [Ω]	Iset [mA]	Rset2 [Ω]	Iset [mA]	Rset2 [Ω]	Iset [mA]
short	min.	255	171	665	335	1740	669	4530	1171	11800	1686
100	100	261	173	681	341	1780	679	4640	1185	12100	1698
102	101	267	175	698	347	1820	689	4750	1198	12400	1708
105	103	274	178	715	354	1870	701	4870	1212	12700	1719
107	104	280	181	732	361	1910	711	4910	1216	13000	1730
110	105	287	184	750	368	1960	724	5110	1239	13300	1739
113	107	294	187	768	374	2000	733	5230	1253	13700	1752
115	108	301	191	787	381	2050	745	5360	1267	14000	1761
118	110	309	194	806	387	2100	757	5490	1281	14300	1771
121	111	316	197	825	394	2160	770	5620	1295	14700	1783
124	113	324	201	845	400	2210	782	5760	1308	15000	1793
127	115	332	204	866	407	2320	806	5900	1322	15400	1802
130	116	340	207	887	414	2360	815	6040	1335	15800	1812
133	118	348	210	909	422	2370	817	6190	1349	16200	1822
137	119	357	214	931	429	2430	829	6340	1362	16500	1829
140	120	365	217	953	436	2490	841	6490	1375	16900	1838
143	122	374	221	976	444	2550	853	6650	1389	17400	1850
147	123	383	225	1000	452	2610	865	6810	1403	17800	1859
150	125	392	229	1020	459	2670	877	6980	1415	18200	1867
154	127	402	233	1050	469	2740	891	7150	1428	18700	1877
158	129	412	237	1070	475	2800	903	7320	1441	19100	1885
162	131	422	241	1100	485	2870	916	7500	1454	19600	1894
165	132	432	246	1130	494	2940	929	7680	1467	20000	1902
169	134	442	250	1150	500	3010	943	7870	1480	20500	1910
174	136	453	254	1180	509	3090	956	8060	1493	21000	1918
178	137	464	259	1210	518	3160	968	8250	1506	21600	1928
182	139	475	263	1240	527	3240	982	8450	1518	22100	1936
187	141	487	268	1270	536	3320	996	8660	1531	23200	1952
191	143	491	270	1300	545	3400	1009	8870	1544	23600	1959
196	145	511	278	1330	554	3480	1022	9090	1557	23700	1960
200	146	523	282	1370	565	3570	1037	9310	1569	24300	1968
205	148	536	287	1400	574	3650	1049	9530	1580	24900	1975
210	151	549	292	1430	582	3740	1062	9760	1592	25500	1982
216	153	562	297	1470	594	3830	1075	10000	1604	26100	1989
221	155	576	302	1500	602	3920	1088	10200	1614	26700	1996
232	161	590	307	1540	614	4020	1103	10500	1629	27000	2000
236	163	604	313	1580	626	4120	1117	10700	1639	open	default
237	164	619	318	1620	638	4220	1131	11000	1653		
243	167	634	323	1650	645	4320	1145	11300	1666		
249	169	649	329	1690	656	4420	1158	11500	1674		

Table 7. Resistance value and corresponding current using Rset2

Rset3 Table for XI095C275V054DNF1M Driver

Rset [Ω]	Current [mA]	Rset [Ω]	Current [mA]	Rset [Ω]	Current [mA]	Rset [Ω]	Current [mA]
0	1000	470	1131	2400	528	12000	2284
100	1029	510	1142	2700	1575	13000	2321
110	1032	560	1154	3000	1619	15000	2383
120	1035	620	1170	3300	1661	16000	2410
130	1038	680	1185	3600	1700	18000	2458
150	1044	750	1202	3900	1737	20000	2499
160	1047	820	1218	4300	1783	22000	2534
180	1052	910	1239	4700	1826	24000	2564
200	1058	1000	1260	5100	1865	27000	2603
220	1064	1100	1282	5600	1912	30000	2635
240	1069	1200	1304	6200	1962	33000	2663
270	1077	1300	1325	6800	2008	36000	2686
300	1086	1500	1366	7500	2057	39000	2707
330	1094	1600	1386	8200	2102	43000	2730
360	1102	1800	1424	9100	2153	47000	2750
390	1110	2000	1460	10000	2199	>47000	2750
430	1121	2200	1495	11000	2244		

Table 8. Rset3 for XI095C275V054DNF1M driver

Please note

Please note that changing the Rset on the driver 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!

Programming the output current

The Philips Advance Xitanium LED drivers with SimpleSet technology 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.

The MultiOne Configurator is an intuitive tool that unlocks the full potential of all programmable drivers from Philips, 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/leddrivers to know if your driver supports SimpleSet or not. For more information on MultiOne visit www.philips.com/multione. This site contains detailed information on how to install the software and how to program the driver.

Philips Advance Xitanium indoor, spotlight 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/leddrivers.

Compatible drivers with Philips Fortimo LED SLM gen 6

A list of compatible Philips Advance Xitanium LED drivers, specific to your choice of module and operating point can be obtained from the Easy Design-in Tool that can be found at https://www.na.easydesignintool.philips.com/. In case of queries, please contact your Philips sales representative.

Philips Advance Xitanium LED driver operating window

LED technology is rapidly evolving. Using more efficient LEDs in a next generation means the same light output can be achieved with lower currents. At the same time, LEDs can be driven at different currents levels based on the application requirement. Typically, LED drivers are available in discrete current levels, e.g., 350mA, 530mA or 700mA. It is often necessary to replace a driver when more efficient LEDs become available.

One of the key features of the Philips Advance Xitanium LED drivers is the adjustable output current (AOC), offering flexibility and future-proof luminaire design. The Xitanium drivers can operate in a certain “operating window.” This window is defined by the maximum and minimum voltage and current that the driver can handle. An example of an operating window is shown in Figure 26. The area indicates the possible current/voltage combinations. The current you select will depend on the type and manufacturer of the LEDs or the specific LED configuration of the PCB design.

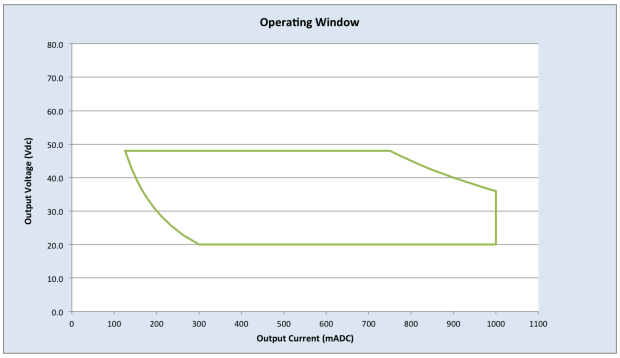
Note: by means of dimming it is possible to go below the minimum value of the specified output current.

The output current of these drivers can be set in two ways.

1. By connecting a specific resistor to the driver's Rset and SGND terminals

2. By dip switches for XI020C050V042RNP1

How to determine what value the output current should be set at will be explained in the next sections.



1. Required operating point
2. Current can be set to needs within range
3. Driver adapts to required voltage, given it fits range
4. Driver minimum power limit
5. Driver maximum power limit

Figure 26. Example operating window for the Xitanium driver (36W in this case).

To select an appropriate driver

Depending on your requirements, several drivers can be a solution for you. The following steps can help you in selecting a driver.

1. Determine your required driver current (Idrive) and voltage (Vf).
2. Calculate the required power (Pdrive) where Pdrive=Vf x Idrive (W).
3. Select the datasheets from the website mentioned in this design-in guide based on the driver having a power greater than the required power.
4. Does the required current fit the current range of the driver? Please check the driver datasheet for maximum and minimum driver current.
    - Idriver min ≤ Idrive ≤ Idriver max?
5. Does the required voltage fit the voltage range of the driver? Please check the driver datasheet for its maximum and minimum voltage range.
    - Vdriver min ≤ Vf ≤ Vdriver max?
6. Does the required power fit the power range of the driver? In the naming of the driver, you can see the maximum power possible. For example, in the XI036C100V048DNMX, the maximum power is 36W. The minimum power is defined as Idriver min x Vdriver min.
    - Pdriver min ≤ Pdrive ≤ Pdriver max?
7. Choose your preferred dimming.

Compatible drivers with Philips Fortimo LED SLM gen 6

In the following graph, you can see examples of the various operating windows for the different Philips Advance Xitanium LED drivers. Based on the previously explained rules, you can now choose the appropriate driver for your Fortimo LED SLM module operating point. A list of different drivers that belong to the windows explained is provided in the graphs in Figure 27 and Figure 28. A list of compatible drivers, specific to your own choice of Fortimo LED SLM module and operating point can be obtained from the Easy Design-in Tool that can be found at https://www.na.easydesignintool.philips.com/. In case of queries, please contact your Philips sales representative.

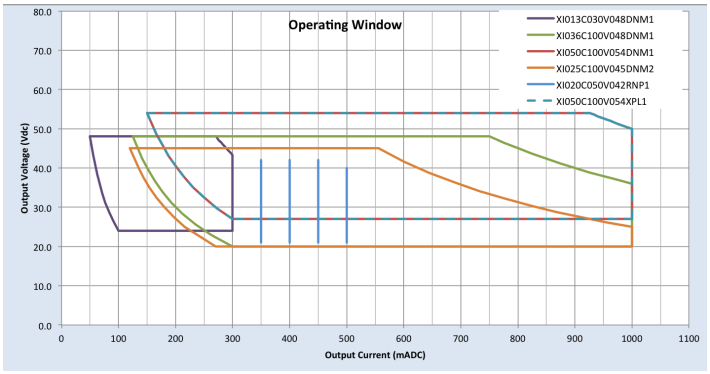


Figure 27. Operating window.

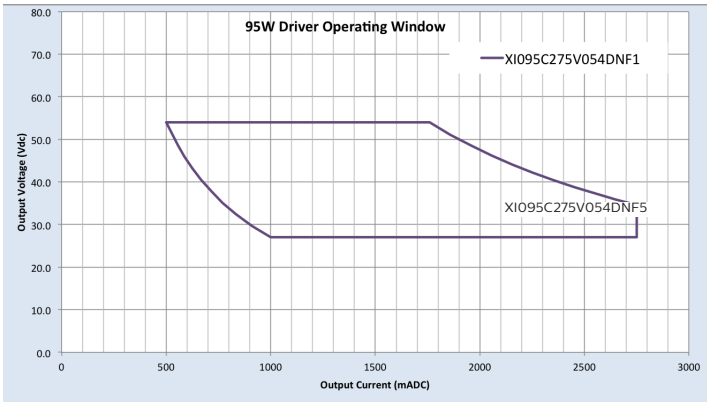


Figure 28. 95W driver operating window.

Controllability

Dimming the Philips Fortimo LED SLM system

As a system, the Philips Fortimo LED SLM modules and Philips Advance Xitanium LED dimmable drivers support dimming between 100% and 1%, depending on the driver specification. The Xitanium driver range supports various dimming protocols. Please refer to the driver design-in guide for more detailed information.

Further information about our entire portfolio of control products is available at www.philips.com/leddrivers.

Reliability

Lumen maintenance

L70B50 @ 50,000 hours[2]

The quality of the Philips Fortimo LED SLM portfolio is backed by the Philips 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 amount of lumens.

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 shown in Figure 28 estimated lumen depreciation curves for different percentage of the population and at nominal Tc temperatures. The actual data for the Fortimo LED SLM modules can be found in the associated datasheets at www.philips.com/ledmodulesna.

Average rated life is based on engineering data testing and probability analysis. The Fortimo LED SLM gen 6 modules are specified to reach L70B50 for the nominal specifications.

Lumen maintenance for B10 and B50

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

Please look up the actual lumen maintenance graph in the associated datasheet of the Fortimo LED SLM you are using at www.philips.com/ledmodulesna.

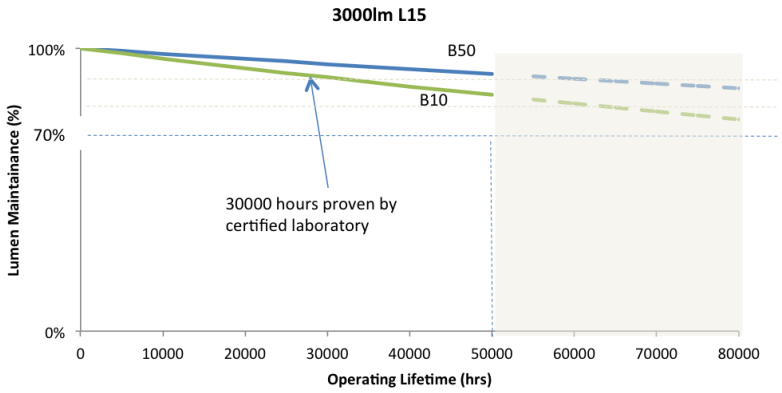


Figure 29. Example lumen maintenance as a function of operating hours for B10 and B50 at Tc nominal.

2 LED lifetime means the length of time (in hours) until half of the LED light sources maintain at least 70% of their initial lumen output (B50,L70).

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 photobiological 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 gen 6 modules using the non-GLS (20 cm) method are listed in the datasheets that can be found at www.philips.com/ledmodulesna.

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/technology. Nevertheless, luminaire makers have to 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).

Crisp white technology

Fortimo LED SLM gen 6 crisp white modules provide the user with intense whites and rich colors. Please note that the product has no UV wavelengths being emitted. A number of 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 photoaging effect from the deep blue flux is observed. If more information is needed, please contact your Philips representative.

Complementary partners

Complementary Reflector Partners
Jordan (www.jordan-reflektoren.de)
NATA (www.nata.cn)
Widegerm (www.widegerm.com.hk)
LEDIL (www.ledil.com)
Almeco (www.almecogroup.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)

Table 9. Complementary partners

Compliance and approval

Compliance and approbation

To ensure luminaire approval, the conditions of acceptance need to be fulfilled. Details can be requested from your local Philips sales representative. All luminaire manufacturers are advised to conform to the UL standard for safety UL1598 or Canadian standard CSA 250-13.

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)

ESD in production environment

Depending on the protection level of the LED module, a minimum set of measures has to be taken when handling LED boards. Philips LED products have a high degree of ESD protection by design. ESD measures are required in a production environment where values can exceed the values shown in the ESD specifications table (Table 11).

ESD specifications

Specifications for Philips Fortimo LED SLM gen 6:

Discharge	Model
<8 kV	Human Body Model (HBM) ANSI/ESD STM5.1-2007
<400V	Machine Model (MM) Class B JESD22-A115-B

Table 10. ESD specifications

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 particular 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 in Table 11. Note that Philips does not warrant that this list is exhaustive because 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
Tetracholorometane	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

Table 11. Common chemicals to avoid

Philips Fortimo LED SLM gen 6 modules comply with the U.S./Canadian standards and regulations shown below.

Safety

UL 8750	LED modules for general lighting – safety specifications
CSA 250.13	CSA standard for LED modules

Philips Advance LED Xitanium driver

UL 8750/UL1310	Lamp control gear

Electromagnetic compatibility

(Tested with Fortimo LED SLM gen 6 modules and Philips Advance LED Xitanium driver)

FCC part 15	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
	Equipment for general lighting purposes – EMC immunity requirements

Cautions

During storage and transportation

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

During operation

Philips shall not be held responsible for any damage 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.

Please note that warranty is applicable for the Philips Fortimo LED SLM modules for one switching cycle per day in combination with a UL Class 2 driver.

Contact details

Visit www.philips.com/ledmodulesna or contact your local Philips sales representative.

Disclaimer

Note that the information provided in this document is subject to change.

This document is not an official testing certificate and cannot be used or construed as a document authorizing or otherwise supporting an official release of a luminaire. The user of this document remains at all times liable and responsible for any and all required testing and approbation prior to the manufacture and sale of any luminaire.

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