



# Design-in guide

Philips Fortimo LED spotlight module (SLM) Gen2

February 2012

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# Introduction to this guide

Thank you for choosing the Philips Fortimo LED Spotlight Module (SLM) Gen2 System. In this guide you will find the information required to design this system into a luminaire.

## Information and support

If you require any further information or support please consult your local Philips office or visit:

- Support [www.philips.com/support](http://www.philips.com/support)
- Fortimo LED SLM [www.philips.com/fortimo](http://www.philips.com/fortimo)
- Xitanium drivers [www.philips.com/xitanium](http://www.philips.com/xitanium)
- OEM general info [www.philips.com/oem](http://www.philips.com/oem)
- North America [www.philips.com/ledmodulesna.com](http://www.philips.com/ledmodulesna.com)



Philips Fortimo LED SLM Gen 2 System for Europe and Asia Pacific



Philips Fortimo LED Spotlight Module Gen 2 System for North America



Fortimo LED Spotlight Module Gen 2



Fortimo LED SLM Gen2 Tight Beam Module

# Spotlight modules, drivers and cables

Philips Fortimo LED Spotlight Module Systems are high-performance, compact, and cost-effective series of products for general and accent lighting. These systems offer long-lifetime and energy efficient lighting solutions for retail, hospitality and general downlighting applications. They are consistent with other Fortimo systems delivering a high quality of light and peace of mind in a future-proof system.

## Can the system be used in outdoor luminaires?

Neither the Fortimo LED module nor the LED driver have an IP classification. If these products are used in luminaires for outdoor applications, it is up to the OEM to ensure proper IP protection and approbation of the luminaire. Please consult us if you wish to deviate from the design rules described in this guide.

## Features of Fortimo LED modules

Fortimo LED modules feature the following:

### 1. High quality of white light

Although LED technology promises high-quality white light in terms of color rendering and color consistency, this does not happen automatically. Today, LED production yields a wide range of colors per batch, and whilst LED binning continues to be a factor one can never be sure that different LED modules will produce exactly the same shade or color of white light. A high degree of technical orchestration of all parts of the system is required on the part of the LED module manufacturer in order to ensure consistent color.

### 2. Leading energy efficiency

The performance of LED technology is improving all the time. Part of the Fortimo brand promise is to continue making use of the latest developments and to implement energy-efficiency upgrades, enabling you to remain competitive without having to re-design your luminaire.

### 3. Future-proof systems

As LEDs become more energy efficient and new bins become available, our LED modules will be upgraded. The new generation of LEDs will be incorporated into the modules, resulting in a higher efficacy, without any change to the dimensions, shape or lumen output of the system. This is a truly future-proof approach to make it easy for luminaire manufacturers to plan and design new luminaire ranges for the years ahead.

### 4. Reliability

With LEDs there are a number of ways in which failures can occur, but strict manufacturing processes and test procedures will secure lifetime and quality. All modules are subject to these measures and meet their published specifications.

### 5. Smart system approach

Fortimo LED modules are always designed and marketed together with a Philips Xitanium or Fortimo driver, as Philips believes that a good system design is crucial to prevent problems and to facilitate easy luminaire integration. There is a wide range of LED drivers available for all Fortimo LED modules, offering plenty of flexibility and choice.



### Module types

There are 22 Fortimo LED SLM Gen2 Modules available as of Feb 2012 in four light output levels (800, 1100, 2000 and 3000 lm) and six different color temperatures and CRI combinations. In addition to these modules, a new Fortimo LED SLM Tight Beam module is also available, in the color 830. More color temperature and CRI combinations are expected later this year.

Fortimo LED SLM Gen2 modules	I2NC
Fortimo LED SLM 800 10W/827 L13 G2	9290 006 97903
Fortimo LED SLM 800 10W/830 L13 G2	9290 006 98003
Fortimo LED SLM 800 9W/835 L13 G2	9290 006 98103
Fortimo LED SLM 800 8W/840 L13 G2	9290 006 98203
Fortimo LED SLM 800 13W/927 L13 G2	9290 006 98303
Fortimo LED SLM 800 12W/930 L13 G2	9290 006 98403
Fortimo LED SLM 1100 15W/827 L13 G2	9290 006 74703
Fortimo LED SLM 1100 14W/830 L13 G2	9290 006 74903
Fortimo LED SLM 1100 13W/835 L13 G2	9290 006 75103
Fortimo LED SLM 1100 12W/840 L13 G2	9290 006 75203
Fortimo LED SLM 1100 20W/927 L13 G2	9290 006 74803
Fortimo LED SLM 1100 18W/930 L13 G2	9290 006 75003
Fortimo LED SLM 2000 26W/827 L19 G2	9290 006 75403
Fortimo LED SLM 2000 24W/830 L19 G2	9290 006 75803
Fortimo LED SLM 2000 23W/835 L19 G2	9290 006 76203
Fortimo LED SLM 2000 20W/840 L19 G2	9290 006 76403
Fortimo LED SLM 2000 35W/927 L19 G2	9290 006 75603
Fortimo LED SLM 2000 32W/930 L19 G2	9290 006 76003
Fortimo LED SLM 3000 42W/827 L19 G2	9290 006 76503
Fortimo LED SLM 3000 39W/830 L19 G2	9290 006 76903
Fortimo LED SLM 3000 40W/835 L19 G2	9290 006 77303
Fortimo LED SLM 3000 36W/840 L19 G2	9290 006 77503

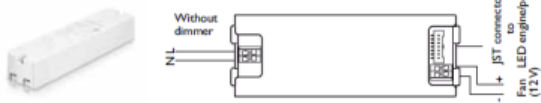
Fortimo LED SLM Gen2 Tight Beam module	I2NC
Fortimo LED SLM 1100 17W/830 L9 G2	9290 006 59403

### Nomenclature of the Fortimo Spotlight Modules

The names of the modules are defined as follows. The Fortimo LED Spotlight Module 2000 24W/830 L19 G2 is used here as an example.

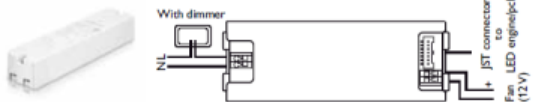
- Fortimo : our brand name for high-quality, efficient, smart, future-proof and reliable LED lighting
- LED : the light source used
- SLM : spotlight module
- 2000 : 2000 lumens
- 24W : 24 W typical module power consumption
- /830 : for a color rendering index >80; 30 stands for a CCT of 3000 K
- L19 : LES (Light Emitting Surface) 19 mm category
- G2 : indicates the second generation

**Fixed output, Independent housing (I)**



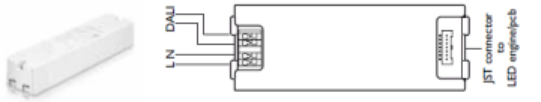
1 Independent 1A 1B Mounting variants

**Trailing Edge (TE), Independent housing (I) housing**



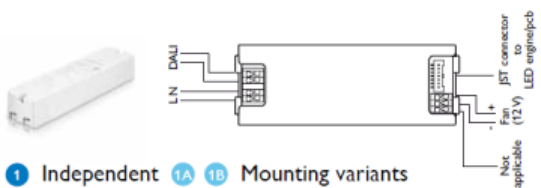
1 Independent 1A 1B Mounting variants

**Touch and DALI (TD), small housing (/s) without 12 V output**

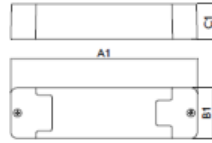


1 Independent 1A 1B Mounting variants

**Touch and DALI (TD), 12V output**

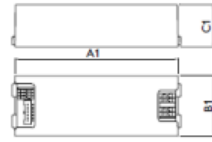


1 Independent 1A 1B Mounting variants



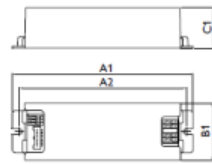
**1 Independent housing**

Type	A1	B1	C1
Xitanium 25W 0.3-0.7A 36V I 230V	190	46	32
Xitanium 25W 0.3-0.7A 36V TE/I 230V	190	46	32
Xitanium 25W 0.3-1A 36V TD/I 230V	170	46	32
Xitanium 25W/0.3-1A 36V TD/Is 230V	150	46	32



**1A Click-on - Mounting variant**

Type	A1	B1	C1
Xitanium 25W 0.3-0.7A 36V I 230V	148	46	32
Xitanium 25W 0.3-0.7A 36V TE/I 230V	148	46	32
Xitanium 25W 0.3-1A 36V TD/I 230V	128	46	32
Xitanium 25W/0.3-1A 36V TD/Is 230V	108	46	32

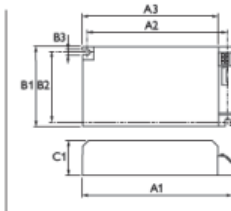
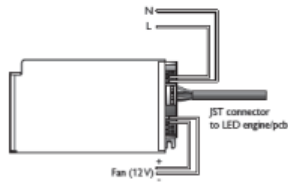


**1B Screw - Mounting variant**

Type	A1	A2	B1	C1
Xitanium 25W 0.3-0.7A 36V I 230V	165	154	46	32
Xitanium 25W 0.3-0.7A 36V TE/I 230V	165	154	46	32
Xitanium 25W 0.3-1A 36V TD/I 230V	145	134	46	32
Xitanium 25W/0.3-1A 36V TD/Is 230V	125	114	46	32

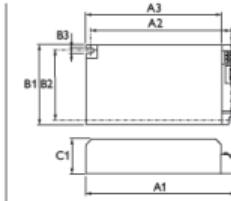
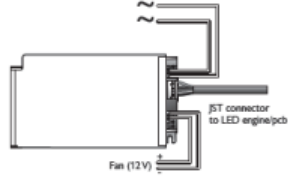
Xitanium 50 W drivers (Europe/Asia Pacific)

**Fixed output**



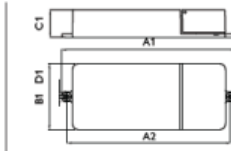
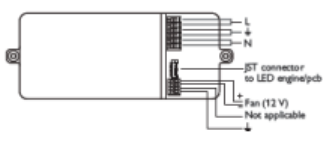
Type	A1	A2	B1	B2	C1
Xitanium 50W 0.3-1A 62V 230V	141	129	75	64	32

**Fixed output, small housing (/s)**



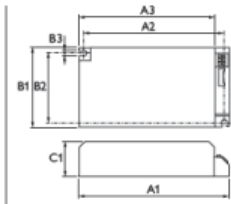
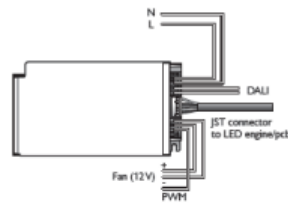
Type	A1	A2	B1	B2	C1
Xitanium 50W/s 0.3-1A 62V 230V	110	99	75	64	32

**Fixed output, Independent housing (I)**



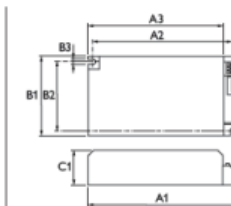
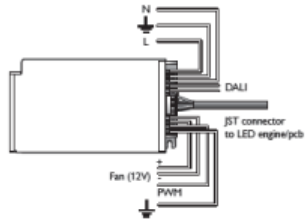
Type	A1	A2	B1	C1
Xitanium 50W SH 0.3-1A 62V I 230V	220	206	83	35

**Touch and DALI (TD), Trailing Edge (TE), built in**



Type	A1	A2	B1	B2	C1
Xitanium 50W 0.3-1A 62V TD/TE 230V	141	129	75	64	32

**Touch and DALI (TD), Trailing Edge (TE), Independent housing (I)**

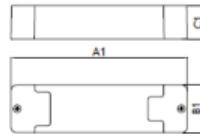


Type	A1	A2	B1	C1
Xitanium 50W SH 0.3-1A 62V TD/TE/I 230V	220	206	83	35

**Touch and DALI (TD), Trailing Edge (TE), Independent housing (I)**

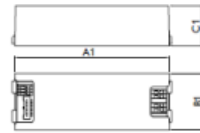


1 Independent 1A 1B Mounting variants



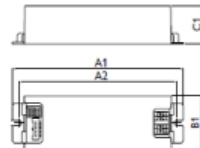
**1 Independent housing**

Type	A1	B1	C1
Xtitanium 50W LH 0.3-1A 62V TD/TE/I 230V	190	46	32



**1A Click-on - Mounting variant**

Type	A1	B1	C1
Xtitanium 50W LH 0.3-1A 62V TD/TE/I 230V	148	46	32



**1B Screw - Mounting variant**

Type	A1	A2	B1	C1
Xtitanium 50W LH 0.3-1A 62V TD/TE/I 230V	165	154	46	32

**Nomenclature of the drivers**

**Housing types**

- I : Independent housing design (Europe/Asia Pacific only)
- LH : Linear housing
- SH : Square housing (Europe/Asia Pacific only)
- SM : SmartMate housing (North America only)

**Dimming protocols**

- TE : Trailing Edge dimming
- TD : Touch & DALI dimming
- 0-10V : 0-10 V dimming

**LED cables for Fortimo LED SLM Gen2 System (Europe/Asia Pacific)**

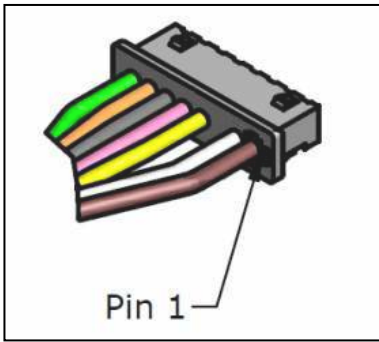
LED SLM cable	I2NC	Cable type
Fortimo LED SLM cable 25 cm	9290 006 14703	A
Fortimo LED SLM cable 60 cm	9290 006 19203	A
Fortimo LED SLM cable 60 cm 12 V	9290 006 32903	A
Fortimo LED SLM cable 60 cm /I	9290 006 95403	B
Fortimo LED SLM cable 60 cm 12 V /I	9290 006 72803	B

**Cable type A**

Two cable lengths, 250 mm and 600 mm, with a wire diameter of AWG28 (0.32 mm), are available to connect the LED drivers. The functions of the wires connected to the LED SLM module are as follows:

1. Black - Current
2. NA
3. NA
4. Yellow - Power ground
5. Red - NTC (thermal control)
6. Blue - LED module setting 1
7. Brown - LED module setting 2
8. Green - Signal ground





Fortimo LED SLM connector for the I cable

#### Cable type B

This cable is ideal for use in combination with the independent LED drivers. The functions of the wires connected to the LED SLM module are as follows:

1. Brown - Current
2. White - Not used
3. NA
4. Yellow - Power ground
5. Pink - NTC (thermal control)
6. Gray - LED module setting 1
7. Orange - LED module setting 2
8. Green - Signal ground

#### Connector details (Europe/Asia Pacific)

The connector between the cable and the SLM LED module is described in the table below.

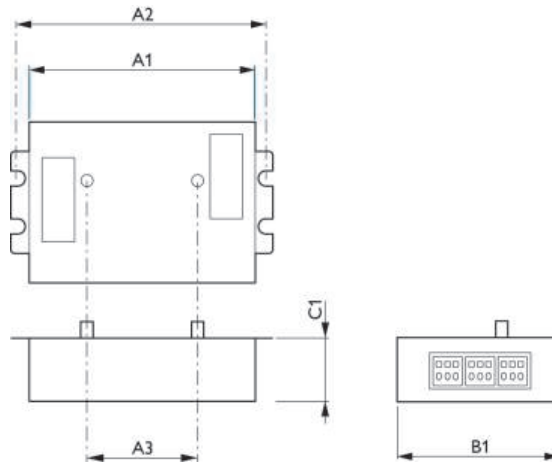
Description	Value
Approbation	UL listed material
Material	Plastic
Type	Tyco HPI 440146-8
Contact	Tyco HPI 440147-2
Number of pins	8
Wire thickness	AWG 28

#### 6Dimensions and specifications of drivers for North America

The dimensions of the Fortimo LED driver 120-277 V 0-10 V Dim and LED drivers with the “SmartMate” (SM) form factor are shown in the table below.



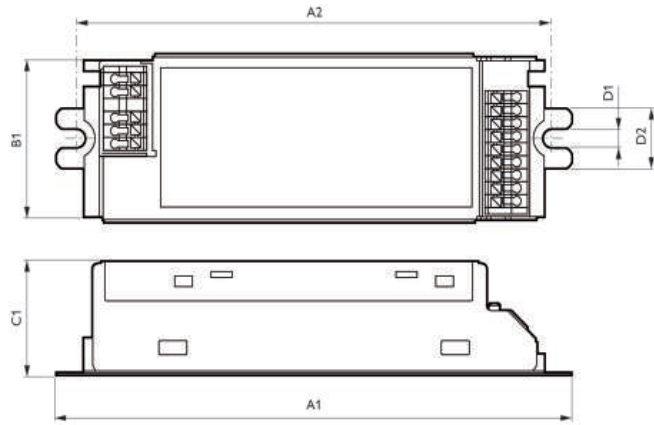
LED driver with the “SmartMate” (SM) form factor



A1 (mm)	A2 (mm)	C1 (mm)	B1 (mm)	A3 (mm)
106.7	116.6	30.0	76.4	50.8



Xitanium 50W LH 0.3-1A 54V TE/0-10V I20-277V

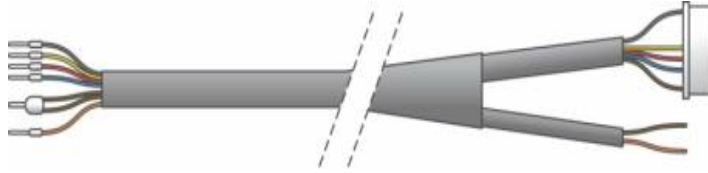


	A1	A2	B1	C1	D1	D2
Xitanium 25W LH 0.3-1A 36V TE/0-10V I20-277V	146	135	46	31	5.2	16
Xitanium 50W LH 0.3-1A 54V TE/0-10V I20-277V	166	154	46	31	5.2	16

**LED cables for Fortimo LED SLM Gen2 System (North America)**

The following cable is available for use with the Xitanium LED driver 120-277 V 0-10 V Dim.

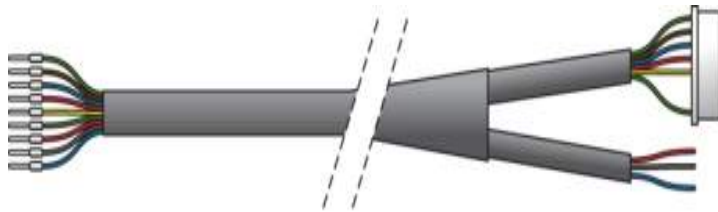
LED SLM cable	I2NC	Region
Fortimo LED SLM cable SM	4422 400 73981	North America



Fortimo LED SLM cable SM

The following cables are available for use with the Xitanium 25/50 W drivers for North America.

LED SLM cable	I2NC	Features
CABLE SLM 9-WIRE TO HPI-8P W-FAN 50CM	9290 006 68003	12 V cable
CABLE SLM 9-WIRE TO 8HPI+4EHR 50CM	9290 006 92003	12 V cable, Nuventix connector
CABLE SLM 9 WIRE TO HPI-8P W/FAN 84CM	9290 006 48103	12 V cable
CABLE SLM 6 WIRE TO HPI-8P 50CM	9290 006 84203	
CABLE SLM 6 WIRE TO HPI-8P 84CM	9290 006 84303	



Cable SLM 9-wire to HPI-8P W-FAN 50 cm

**Connector information**

Part number	Description
HPI 440146-8	TYCO Connector
HPI 440147-2	TYCO Contact
966066-4	TYCO Wire Ferrule
966289-1	TYCO Two Wire Ferrule
62194-2	TYCO Spice

#### Details of connector to the LED module

Description	Value
Approbation	UL listed material
Material	Plastic
Type	Tyco HPI 440146-8
Contact	Tyco HPI 440147-2
Number of pins	8
Wire thickness	AWG 28

#### Details of connector to the driver

Description	Value	Comment
Approbation	UL listed material	
Material	Plastic	
Type	JST PAP-07V-S	UL file E60389
Contact	JST SPHD-002T-P0.5	AWG 28 to 24
Number of pins	7	
Wire thickness	AWG 28	

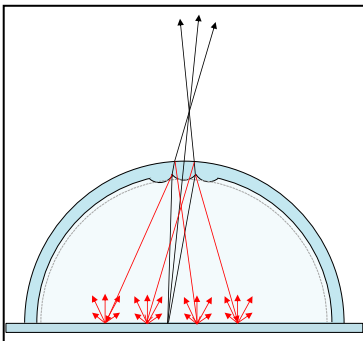
#### OEM-developed cables

We recommend you use Philips Fortimo LED SLM cables. However, if you prefer to develop your own cables the specification must meet UL, CSA & IEC/EN requirements. Please bear in mind that the approval for the Fortimo LED Spotlight Module and driver is based on use of a reference luminaire with a standard cable length of 60 cm. Any luminaire design will require its own approval, to be arranged by the OEM, irrespective of the length of cable used.

# Technical lighting design



Fortimo LED SLM Gen2



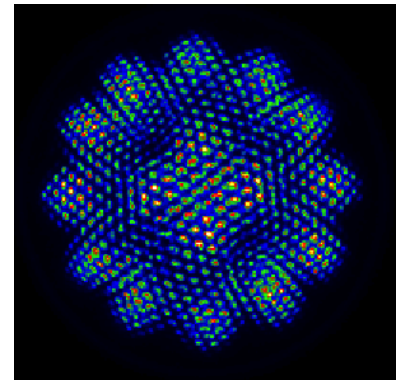
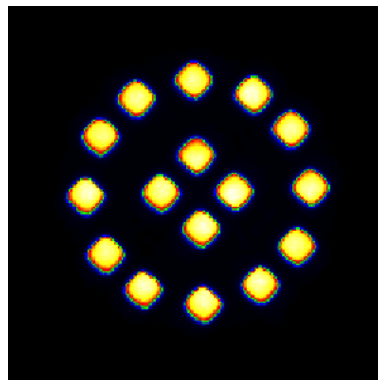
Working principle of the optical mixing dome

## Optical mixing dome (not applicable to Tight Beam module)

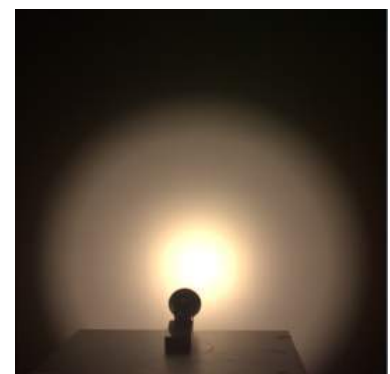
One of the major improvements in the Fortimo LED SLM Gen2 System is the addition of an optical mixing dome. This ensures the creation of a smooth and uniform beam in combination with every type of reflector, even specular (non-mixing) ones. In addition to that, multiple shadows (rings) are no longer visible at the edge of the beam. It is therefore no longer necessary to use a diffuser at the exit aperture of the reflector to eliminate these rings.

Due to the optimized design (patent pending) of the optical mixing dome, its optical efficiency is typically 97%. The table below shows the impact of the mixing dome on some key beam parameters, with a Jordan (reflector 1) and Alux Luxar (reflector 2) reflector shown as examples.

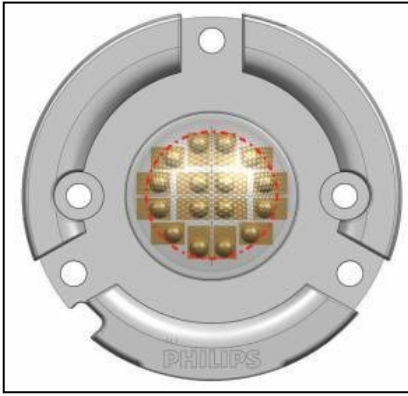
	With optical dome	Without optical dome
Module flux	100%	103%
Beam angle (FWHM) reflector 1	27°	27°
Beam angle (FWHM) reflector 2	22°	22°
Candela power (CBCP) reflector 1	4.7 kCd	5.0 kCd
Candela power (CBCP) reflector 2	5.6 kCd	6.0 kCd



Emitted intensity of an Spotlight Module with (right) and without (left) optical mixing dome.



The effect of the optical mixing dome on the light distribution of a Spotlight Module with a typical reflector. Left the beam without optical mixing dome, right the beam with the optical mixing dome.



The light-emitting surface (LES) is indicated by the red dotted circle.

### Brightness

The Fortimo LED Spotlight Modules Gen 2 are optimized for accent lighting by creating a very high brightness ( $\text{lm}/\text{mm}^2$ ). The light-emitting surface (LES) is defined as the smallest diameter around the light-emitting LEDs. The diameter of the mixing dome is larger, but this has very little impact on the optical source diameter. The new Fortimo LED SLM Tight Beam module offers a very high brightness in an LED spot module.

The effect of the brightness of the LED module on the Cd value of an accent lighting luminaire with a given reflector design is shown in the table below.

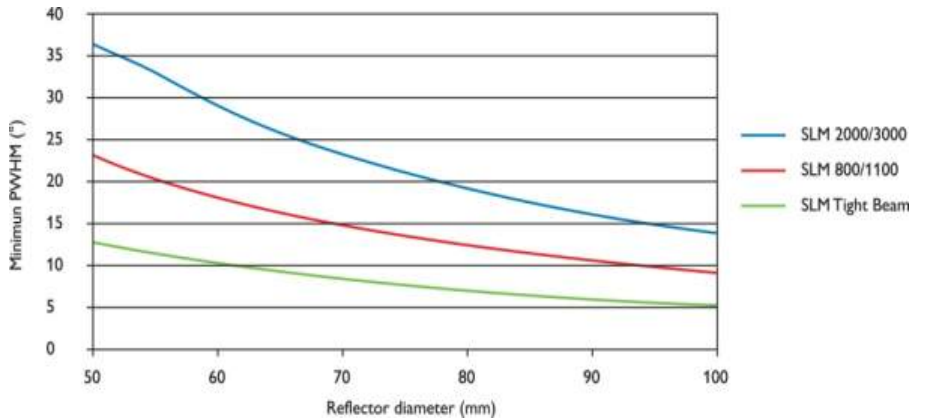
Parameter	Module A	Module B
Light output (lm)	1100	1100
Light-emitting surface (LES) diameter (mm)	13	9
Light-emitting surface (LES) area ( $\text{mm}^2$ )	133	64
Center-beam candela power (Cd)	48%	100%

The table below shows the typical Cd values that can be achieved with Fortimo LED SLM Gen2 at certain beam angles, assuming a Gaussian light distribution.

Module	2x3°	2x7°	2x12°	2x20°
SLM 3000		27,000 Cd	12,000Cd	4,400Cd
SLM 2000		18,000 Cd	7,800Cd	3,000Cd
SLM 1100		9,800 Cd	4,300 Cd	1,600 Cd
SLM 1100 Tight Beam	47,000 Cd	9,800 Cd	4,300 Cd	1,600 Cd
SLM 800		7,100 Cd	3,100 Cd	1,200 Cd

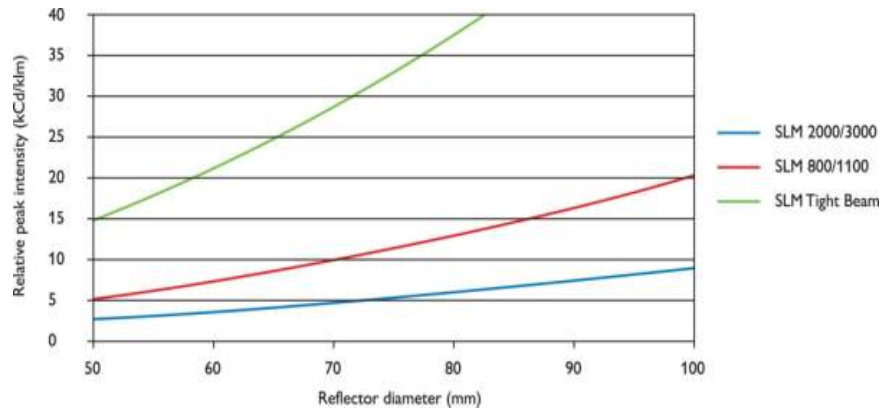
### Reflector design limits

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 Gen2.



The above graph simulates the expected beam angles based on standard light emitting surface and a 60mm high reflector.





The above graph simulates the expected beam intensities based on standard light emitting surface and a 60mm high reflector.

Note that the following assumptions are made for the graphs above:

- perfect Lambertian source
- etendue limited reflector design
- gaussian beam
- two light paths used:
  1. Direct light, not hitting the reflector;
  2. Reflected light, single reflection, reflectivity 90% .

Not included in the calculations:

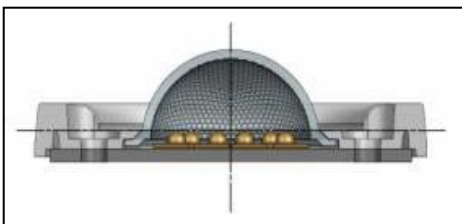
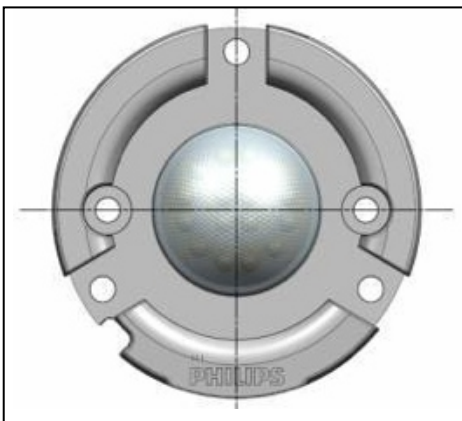
- reflector design
- reflector rim diameter
- convergent beam.

#### Ray sets

The following ray set files are available for customer use, and can be downloaded from [www.philips.com/fortimo](http://www.philips.com/fortimo). All ray set files are available for 100 K, 500 K, and 5 M rays.

Software	File extension
Radiant Imaging (measurement file)	.rs8
ASAP	.dis
Light Tools (ASCII)	.ray (zipped)
LucidShape	.ray
Optis/Speos	.ray
Photopia	.rir
TracePro/Oslo (ASCII)	.dat (zipped)
Zemax	.dat

The origin of the ray sets is shown in the pictures on the left, where x, y and z=0 lines are drawn. For the ray set generation, the edge of the module cover was removed to enable the light emitted to be collected at the base of the dome at shallow angles.



The origin of the ray set files, centered on the dome at the level of the optical contact area.

### Color rendering values

The table below shows the indicative R-values for the Fortimo LED Spotlight Gen 2 Modules. Please contact your local sales representative for the latest product specifications

SLM module type	Ra8	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
800 827	85	84	91	98	85	84	90	86	66	23	80	85	76	85	98
800 830	86	84	90	96	86	84	88	88	68	25	77	86	72	85	97
800 835	83	82	88	92	84	82	84	86	69	23	71	83	72	83	95
800 840	86	85	90	93	86	85	86	88	73	30	75	85	72	85	96
800 927	97	99	98	99	99	99	95	95	93	86	98	98	89	99	99
800 930	96	99	98	95	95	98	97	95	94	87	94	94	94	99	96
1100 827	85	83	90	97	84	83	89	86	65	22	79	84	75	85	98
1100 830	85	83	90	96	85	83	87	87	68	24	76	85	72	85	97
1100 835	85	83	90	95	84	84	86	87	69	26	76	83	75	85	97
1100 840	85	84	89	92	85	84	85	88	73	29	73	84	72	85	95
1100 927	96	98	98	97	96	98	98	94	91	81	96	96	96	99	97
1100 930	96	99	98	95	95	98	97	94	93	85	94	95	94	99	96
1100 830 Tight Beam	81	81	86	89	82	79	80	86	68	22	66	80	61	81	93
2000 827	85	83	90	97	84	83	89	86	65	22	79	85	75	85	98
2000 830	85	83	89	95	85	83	87	88	68	23	75	85	71	84	97
2000 835	85	83	90	96	84	83	86	88	70	24	76	82	69	84	97
2000 840	86	85	90	94	85	85	86	89	73	31	76	84	71	86	96
2000 927	95	97	97	95	94	96	97	93	89	78	93	95	94	97	96
2000 930	96	99	98	96	95	98	97	95	93	85	95	95	94	99	97
3000 827	84	82	90	97	83	82	88	86	65	20	77	83	73	84	98
3000 830	85	83	90	96	84	83	87	87	67	23	76	84	71	84	97
3000 835	84	82	89	94	83	82	85	87	68	22	74	81	71	83	97
3000 840	86	85	91	94	85	85	87	88	73	31	77	83	71	86	97

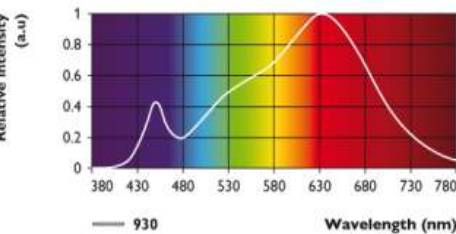
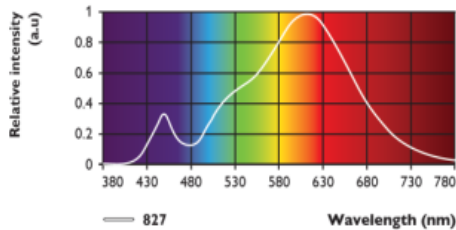
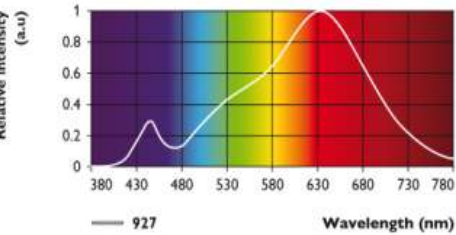
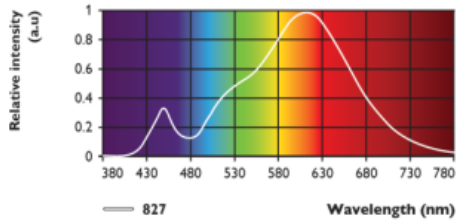
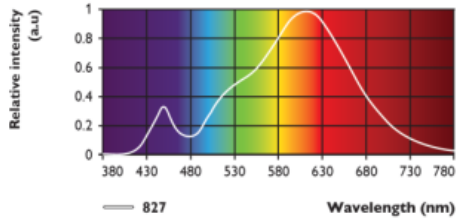
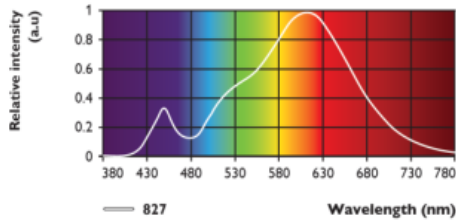
Note: Philips maintains a tolerance of  $\pm 2$  on CRI measurements.

### Color consistency (SDCM)

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 specification of the Fortimo LED Gen 2 Spotlight Module is 3 SDCM @ 0 hours. This results in a color consistency such that there is no perceivable difference between one luminaire and another. The detailed specification of color consistency can be found in the table below. Note that color consistency performance is tested by Philips.

Fortimo LED SLM Gen2 module types	Color consistency specification
827	100% of population $\leq 3$ SDCM
830	100% of population $\leq 3$ SDCM
835	>90% of population $\leq 3$ SDCM, 100% of population $\leq 4$ SDCM
840	>90% of population $\leq 3$ SDCM, 100% of population $\leq 4$ SDCM
927	>90% of population $\leq 3$ SDCM, 100% of population $\leq 4$ SDCM
930	>90% of population $\leq 3$ SDCM, 100% of population $\leq 4$ SDCM
830 Tight Beam	100% of population $\leq 3$ SDCM

Note: Philips maintains a tolerance of  $\pm 0.001$  on x, y color point measurements.



### Color targets

The color target points of the Fortimo LED Gen2 Spotlight Modules are shown in the table below.

Fortimo LED SLM Gen2 modules	Color target point CIE <sub>x</sub>	Color target point CIE <sub>y</sub>
Fortimo LED SLM 800 10W/827 L13 G2	0.459	0.411
Fortimo LED SLM 800 10W/830 L13 G2	0.436	0.404
Fortimo LED SLM 800 9W/835 L13 G2	0.407	0.388
Fortimo LED SLM 800 8W/840 L13 G2	0.381	0.374
Fortimo LED SLM 800 13W/927 L13 G2	0.467	0.407
Fortimo LED SLM 800 12W/930 L13 G2	0.442	0.396
Fortimo LED SLM 1100 15W/827 L13 G2	0.457	0.410
Fortimo LED SLM 1100 14W/830 L13 G2	0.434	0.403
Fortimo LED SLM 1100 13W/835 L13 G2	0.406	0.387
Fortimo LED SLM 1100 12W/840 L13 G2	0.380	0.374
Fortimo LED SLM 1100 20W/927 L13 G2	0.467	0.406
Fortimo LED SLM 1100 18W/930 L13 G2	0.442	0.395
Fortimo LED SLM 1100 17W/830 L9 G2 (Tight Beam)	0.431	0.398
Fortimo LED SLM 2000 26W/827 L19 G2	0.457	0.410
Fortimo LED SLM 2000 24W/830 L19 G2	0.434	0.403
Fortimo LED SLM 2000 23W/835 L19 G2	0.407	0.388
Fortimo LED SLM 2000 20W/840 L19 G2	0.381	0.374
Fortimo LED SLM 2000 35W/927 L19 G2	0.464	0.403
Fortimo LED SLM 2000 32W/930 L19 G2	0.441	0.396
Fortimo LED SLM 3000 42W/827 L19 G2	0.453	0.408
Fortimo LED SLM 3000 39W/830 L19 G2	0.431	0.401
Fortimo LED SLM 3000 40W/835 L19 G2	0.407	0.387
Fortimo LED SLM 3000 36W/840 L19 G2	0.379	0.372

Note: Philips maintains a tolerance of ± on x, y color point measurements

### Spectral light distribution

The spectral light distribution of the Fortimo LED SLM Gen2 is shown in the figures on the left.

Spectral light distribution of the various Fortimo LED SLM Gen2

### Complementary reflector partners

Secondary optics 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 reflector companies who have a standard portfolio of compatible reflectors available, enabling quick and easy luminaire creation.

The following are suggestions of companies that offer reflector products that can be used with the Fortimo LED SLM system. Reference to these companies does not constitute their endorsement by Philips. Philips makes no warranties regarding any products sold by their companies and assumes no legal liability or responsibility for any loss or damage resulting from the use of the information herein.

Company
Alux Luxar ( <a href="http://www.alux-luxar.de">www.alux-luxar.de</a> )
Jordan ( <a href="http://www.jordan-reflektoren.de">www.jordan-reflektoren.de</a> )
NATA ( <a href="http://www.nata.cn/">www.nata.cn/</a> )
Wildegerm ( <a href="http://www.widegerm.com.hk">www.widegerm.com.hk</a> )
ACL ( <a href="http://www.reflektor.de">www.reflektor.de</a> )
Almecco ( <a href="http://www.almecco.it">www.almecco.it</a> )
Ledil ( <a href="http://www.ledil.fi">www.ledil.fi</a> )

### Starting characteristics

The Fortimo modules can be switched on in milliseconds, which is a general characteristic of LEDs. When used within specification (module  $T_c \leq 75^\circ\text{C}$ ), a minimum lumen maintenance of 70% at 50,000 hours should occur.

# Mechanical design

## Fortimo LED SLM Gen2 module dimensions

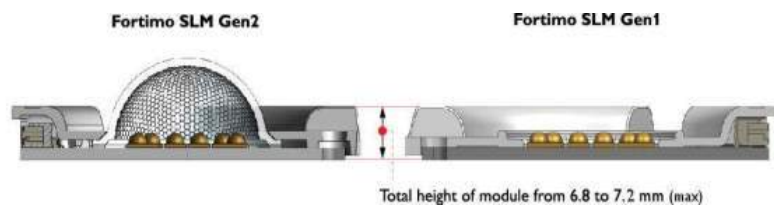
The Fortimo LED Gen2 Spotlight Module has been slightly modified compared to the Gen1 version in order to comply with the Zhaga standard for LED accent lighting modules. Additional functionalities have been added too. Three dimensional CAD files can be downloaded from our website [www.philips.com/fortimo](http://www.philips.com/fortimo).

## Differences between the Fortimo LED SLM Gen2 and Gen1

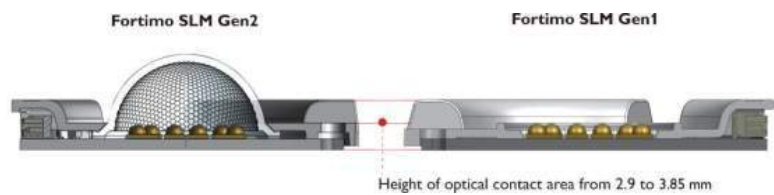
The images below show the minor changes made to SLM Gen2 compared to SLM Gen1



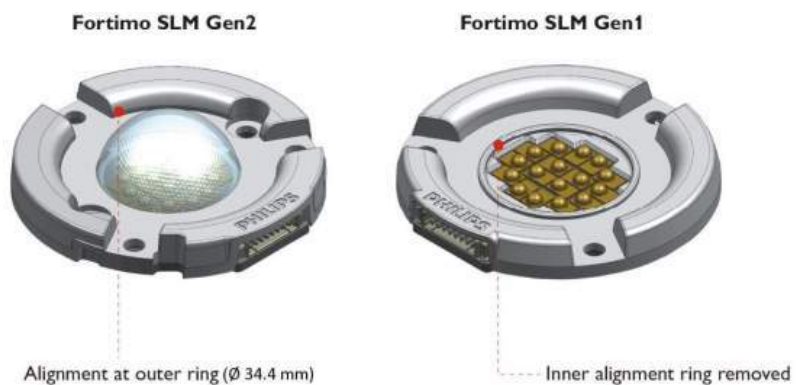
Fortimo LED SLM Gen2 vs. Gen1 – mounting holes and diameter



Fortimo LED SLM Gen2 vs. Gen1 – height of module

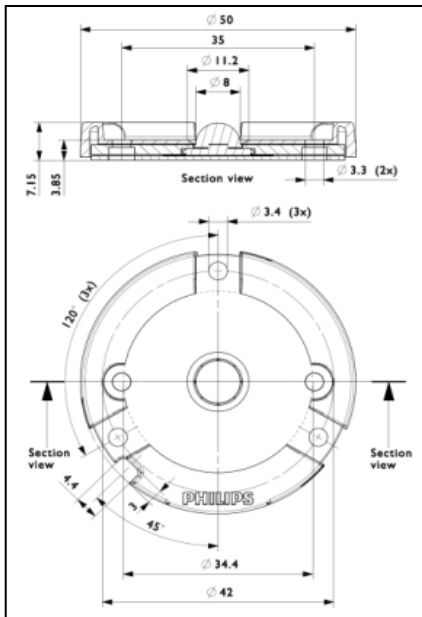


Fortimo LED SLM Gen2 vs. Gen1 – height of optical contact area

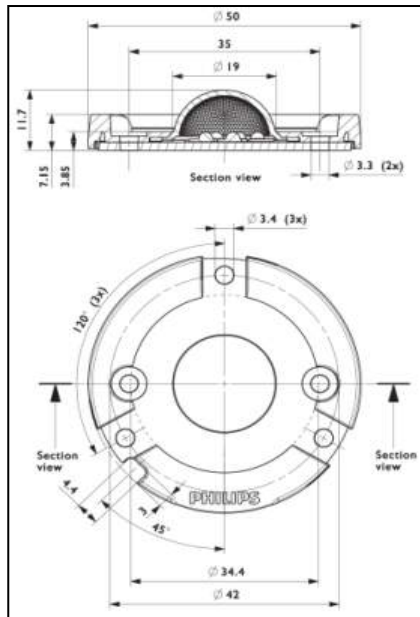


Fortimo LED SLM Gen2 vs. Gen1 – alignment of inner and outer ring

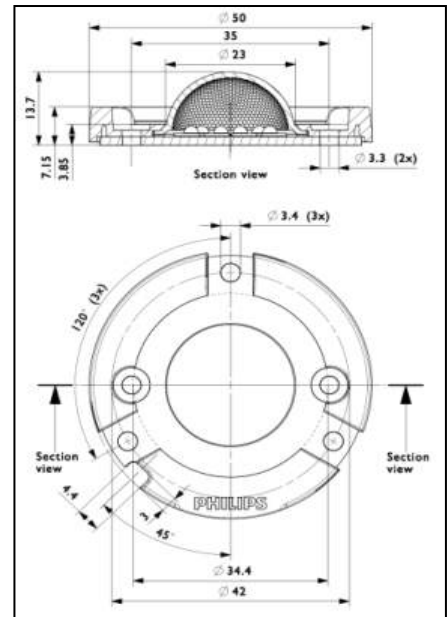
## Dimensions of the Fortimo LED Spotlight Module



Dimensions of the Fortimo LED SLM 1100 Gen2 Tight Beam module



Dimensions of the Fortimo LED SLM 800/1100 Gen2 module



Dimensions of the Fortimo LED SLM 2000/3000 Gen2 module

### Additional mechanical features

Fortimo LED SLM Gen2 has two additional mechanical features:

- 3x twist-and-lock reflector attachment functionality on the outside of the LED module.
- Anti-rotation notch to enable the use of a locking ring (LED holder), as defined in the upcoming industry standard for LED accent lighting modules.



Additional mechanical features of the Fortimo LED SLM Gen2

### Recommended torque

The recommended torque for mechanical fixation of the Fortimo LED SLM Gen2 modules to the heat sink is 0.6Nm (assuming pre-taped holes are present in the heat sink).



# Thermal management

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. These thermal points should be taken into account, to provide optimum performance and life of the LED system.

## Optimum performance

The Fortimo LED SLM system must operate within specified temperature limit for optimal performance.

## Test requirements

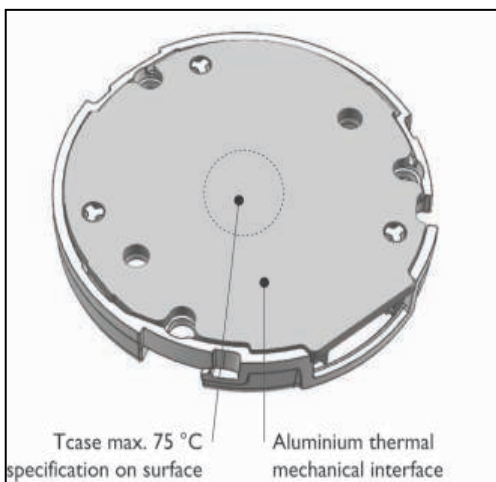
Measurements of temperature, luminous flux and power, are reliable once the luminaire is thermally stable this may take between 0.5 and 2 hours. The length of time depends on the thermal capacity of the luminaire (see also the relevant clauses in IEC 60598).

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 light sources.

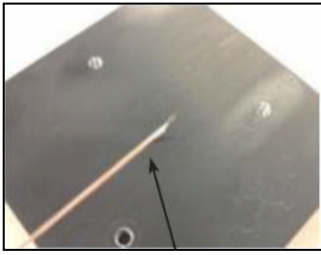
For LEDs the junction temperature is the critical factor for operation. Since there is a direct relation between the case temperature and the LED junction temperature you must measure the aluminum casing of the LED module at its critical point. The critical point is on the rear surface of the LED module, as shown in the figure on the left. If the case temperature ( $T_c$ ) at the critical measurement point exceeds the recommended maximum temperature ( $75^\circ\text{C}$ ) the performance of the LEDs may be adversely affected.



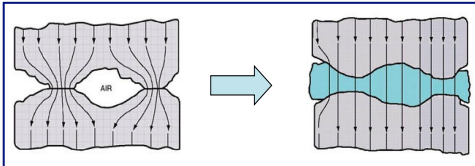
## Warning

### Case temperature and thermal circuit

For the performance of the Fortimo LED SLM system we have defined a maximum  $T_c$  of  $75^\circ\text{C}$  on the rear surface of the LED module. This case temperature is needed for proper junction temperature of the LEDs and the performance indicated (lifetime, light output, lumen maintenance, etc.). Above a  $T_c$  of  $75^\circ\text{C}$ , a thermal circuit in the driver will be activated. This circuit will dim the LED module until the  $T_c$  of  $75^\circ\text{C}$  is reached again. Then the module will return to full output once the module  $T_c$  returns below  $75^\circ\text{C}$ . Note that the maximum  $T_c$  value for the Fortimo LED SLM Gen2 is  $10^\circ\text{C}$  higher than for the Fortimo LED SLM Gen1, allowing much more compact and cost-effective heat sinks to be used.



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



The working principle of thermal interface material

### How to measure the critical temperature point $T_c$

The  $T_c$  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).

The function of a TIM 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.

### Thermal Interface Material (TIM)

In general:

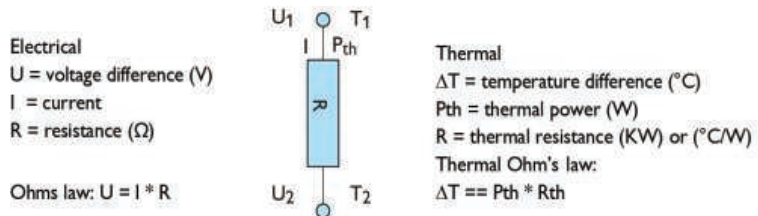
- Thermal paste performs better than thermal pads.
- The lower the thermal impedance the better.
- The thinner the TIM the better.

The following are suggestions for thermal interface material products that can be used with the Fortimo LED Spotlight Module System. Reference to these companies does not constitute their endorsement by Philips. Philips makes no warranties regarding these companies and assumes no legal liability or responsibility for any loss or damage resulting from the use of the information herein.

Company
Laird Technologies ( <a href="http://www.lairdtech.com">www.lairdtech.com</a> )
The Bergquist Company ( <a href="http://www.bergquistcompany.com">www.bergquistcompany.com</a> )

### 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 the figure entitled 'Electrical and thermal analogy' below. The electrical units are shown on the left, while the thermal equivalents are given on the right. 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.

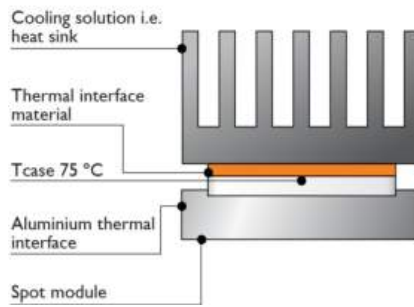


Electrical and thermal analogy

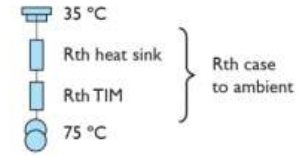
### Thermal model

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

#### Simplified model



#### Thermal path



A simplified model of the thermal path from LED module to ambient

### Thermal design of a heat sink

The table below shows the required thermal resistance ( $R_{th}$ ) of the heat sink and TIM for various ambient temperatures, using the maximum permitted LED module power. With these  $R_{th}$ 's, the  $T_c$  of the module will stay below the maximum of 75°C at the ambient temperature stated.



#### Warning

The maximum temperature difference between  $T_c$  and  $T_{ambient}$  should never exceed 50 °C, otherwise it could lead to a reduction in the lifetime of the system.

### Thermal resistance in relation to ambient temperatures

SLM Gen2 thermal power	800/927	800/930	800/827	800/830	800/835	800/840
Max. thermal Power (W)	11.2	10.0	8.3	7.9	7.0	6.0

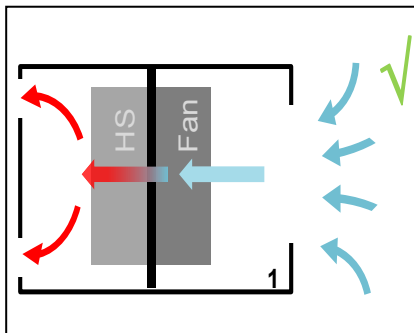
SLM Gen2 required Rth's	800/927	800/930	800/827	800/830	800/835	800/840
Ambient temperature						
55°C	<1.78	<2.00	<2.40	<2.54	<2.87	<3.31
50°C	<2.23	<2.50	<3.00	<3.18	<3.59	<4.14
45°C	<2.67	<3.00	<3.60	<3.81	<4.31	<4.97
40°C	<3.12	<3.50	<4.21	<4.45	<5.02	<5.79
35°C	<3.56	<3.99	<4.81	<5.08	<5.74	<6.62
30°C	<4.01	<4.49	<5.41	<5.72	<6.46	<7.45
25°C	<4.45	<4.99	<6.01	<6.35	<7.18	<8.28

SLM Gen2 thermal power	I 100/927	I 100/930	I 100/827	I 100/830	I 100/835	I 100/840	I 100/830 Tight Beam
Max. thermal Power (W)	17.0	14.6	11.8	10.9	10.0	9.0	14.2

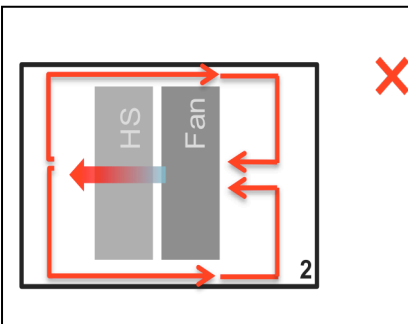
SLM Gen2 required Rth's	I 100/927	I 100/930	I 100/827	I 100/830	I 100/835	I 100/840	I 100/830 Tight Beam
Ambient temperature							
55°C	<1.17	<1.37	<1.70	<1.84	<1.99	<2.23	<1.41
50°C	<1.47	<1.72	<2.13	<2.30	<2.49	<2.79	<1.77
45°C	<1.76	<2.06	<2.55	<2.76	<2.99	<3.34	<2.12
40°C	<2.06	<2.40	<2.98	<3.22	<3.49	<3.90	<2.47
35	<2.35	<2.75	<3.40	<3.68	<3.99	<4.46	<2.83
30°C	<2.64	<3.09	<3.83	<4.14	<4.49	<5.02	<3.18
25°C	<2.94	<3.43	<4.25	<4.60	<4.98	<5.57	<3.53

SLM Gen2 thermal power	3000/82 7	3000/83 0	3000/83 5	3000/84 0	2000/92 7	2000/93 0	2000/82 7	2000/83 0	2000/83 5	2000/83 40
Max. thermal Power (W)	36.6	32.5	33.3	29.4	28.5	24.8	19.8	18.0	18.9	16.6

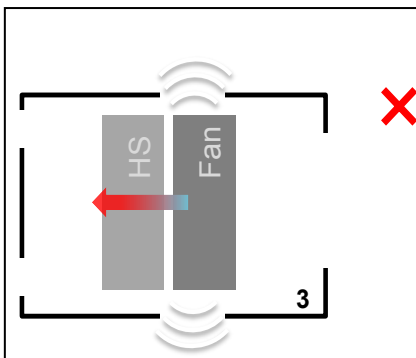
SLM Gen2 required Rth's	3000/82 7	3000/83 0	3000/83 5	3000/84 0	2000/92 7	2000/93 0	2000/82 7	2000/83 0	2000/83 5	2000/83 40
Ambient temperature										
55°C	<0.55	<0.62	<0.60	<0.68	<0.70	<0.81	<1.01	<1.11	<1.06	<1.21
50°C	<0.68	<0.77	<0.75	<0.85	<0.88	<1.01	<1.26	<1.39	<1.32	<1.51
45°C	<0.82	<0.92	<0.90	<1.02	<1.05	<1.21	<1.51	<1.67	<1.59	<1.81
40°C	<0.96	<1.08	<1.05	<1.19	<1.23	<1.41	<1.77	<1.95	<1.85	<2.11
35°C	<1.09	<1.23	<1.20	<1.36	<1.41	<1.61	<2.02	<2.23	<2.12	<2.41
30°C	<1.23	<1.39	<1.35	<1.53	<1.58	<1.81	<2.27	<2.51	<2.38	<2.71
25°C	<1.36	<1.54	<1.50	<1.70	<1.76	<2.02	<2.52	<2.79	<2.65	<3.02



Design guidelines for active cooling solutions Image 1



(Image 2)



(Image 3).

### Active and passive cooling

In theory two thermal solutions are possible.

#### 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 (Image 1).
- 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 (Image 2) 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 (Image 3) should be avoided in order to help contain any noise from the fan.

Passive cooling systems are based on the fact that hot air moves upwards, thus creating an 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

#### Passive cooling

Passive cooling systems are based on the fact that hot air moves upwards, thus creating an 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

Before starting to perform any calculations, an important point to consider is the airflow. In general hot air moves upwards 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.

# Electrical design

## Connection to the mains supply

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

## Class I and Class II (Europe/Asia Pacific only)

A Class I product is a luminaire which is connected to protective earth. All materials that can conduct electricity should be connected to the protective earth. In the event of a driver failure, it is possible that electrically conductive parts of the luminaire could come into contact with the mains.

In a Class II product the driver design is such that in the event of single fault conditions the electrically conductive parts of the luminaire cannot come into electrical contact with the mains. As the maximum voltage of the Fortimo LED SLM is below 60 V, it complies with the rules governing Safety Extra Low Voltage (SELV) and is therefore designed to be touched. This means that connection to a protective earth is not necessary.

## Class II (North America)

Reference UL 1598 for wiring practices.

## Connection to DALI

The “TD” LED drivers incorporate connectors for DALI-compatible user interfaces (controls).

## Connection to 12 V

All Xitanium LED drivers of 25 W and higher also feature a 12 V output that can be used for various options, such as:

- Active cooling by 12 V operating fans.
- Connection to other high-power or low-power LEDs to add decorative lighting effects to your luminaire.

## Inrush current

Detailed information about the inrush currents of the various drivers can be found in the Xitanium driver design-in guide (Europe/Asia Pacific) or in the driver datasheets (North America).

More information on Philips Xitanium LED drivers can be found at [www.philips.com/xitanium](http://www.philips.com/xitanium) or [www.philips.com/ledmodulesna.com](http://www.philips.com/ledmodulesna.com) (North America).



# Controllability for 200-240 V countries



OccuSwitch DALI



ActiLume DALI



ToBeTouched DALI

## Dimming the Philips Fortimo LED SLM system

As a system, the Philips Fortimo LED SLM and Xitanium dimmable drivers support dimming between 100% and 10%, depending on the driver specification. The Xitanium driver supports various dimming protocols.

Please refer to the driver manual for more detailed information.

## Philips lighting control systems

For DALI systems we recommend:

- OccuSwitch DALI
- ActiLume DALI
- ToBeTouched DALI
- Dynalite solutions (via Philips VAR network)

For fixed-output switching we recommend:

- OccuSwitch (switch on/off using fixed-output drivers)

Further information about our entire portfolio of control products is available at:

[www.philips.com/lightingcontrols](http://www.philips.com/lightingcontrols).

# Controllability for North American region



OccuSwitch

## Dimming the Philips Fortimo LED SLM system

As a system, the Philips Fortimo LED SLM and Xitanium 25/50W driver support dimming between 100% and 10%, depending on the driver specification. The Xitanium drivers support various dimming protocols. Please refer to the driver manual for more detailed information regarding dimming interfaces.

## Philips lighting control systems

For DALI systems we recommend:

- Dynalite Networked Solutions
- ActiLume DALI

For 0-10 V systems or fixed-output switching we recommend:

- OccuSwitch family of sensors
- ActiLume I-10 V

Further information about our entire portfolio of control products is available at: [www.philips.com/lightingcontrolsna](http://www.philips.com/lightingcontrolsna).



ActiLume DALI



ActiLume I-10 V

# Compliance and approval

## Compliance and approval marks [Approbation compliance](#)

Systems for Europe and Asia Pacific are ENEC-certified. Systems for North America are UL (8750) and CSA-certified. All systems comply with IEC 62031 and CE regulations.

All luminaire manufacturers are advised to conform to the applicable standards of luminaire design.

## [IP rating, humidity and condensation](#)

The Fortimo LED SLM systems are build-in systems and therefore have no IP classification. They are not designed for operation in the open air. The OEM is responsible for proper IP classification and approbation of the luminaire.

**Examples of applicable standards**

IEC/EN 62031 LED modules for general lighting - safety specifications  
 IEC 62471 Photobiological safety of lamps and lamp systems  
 UL 8750 Light Emitting Diode (LED) Equipment for Use in Lighting Products

Philips Xitanium driver  
 IEC/EN 61347-1 Lamp control gear

CSA

Electromagnetic compatibility (tested with LED SLMs, cables and Philips Xitanium driver)  
 EN 55015, CISPR 55015 Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment  
 IEC/EN 61000-3-2 Limits for harmonic current emissions (equipment input current <16 A per phase)  
 IEC/EN 61547 Equipment for general lighting purposes - EMC immunity requirements

**Environmental**

The product is compliant with European Directive 2002/95/EC of January 2003 on Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).

**Environmental reliability tests**

Test name	Reference	Test conditions
Low-temperature storage	IEC/EN 60068-2-1	Tamb -40 °C
High-heat storage	IEC/EN 60068-2-2	Tamb +100 °C
Non-operational thermal shock	IEC/EN 60068-2-14	Tamb -40 ...+125 °C, Xfer 20s, Dwell 28 min
Operational life, continuous operation	IEC/EN 60068-2-2	Tamb +35 °C
Operational life, power cycle	IEC/EN 60068-2-2	Tamb +35 °C; on/off 60/60 min

**Mechanical reliability tests**

Change temperature, storage	IEC/EN 60068-2-14	Tamb -40 ...+100 °C, Xfer 30 min, Dwell 30 min
Change temperature, operational	IEC/EN 60068-2-14	Tamb -40 ...+85 °C, cycle 60 min, Dwell 20 min
Damp heat, operation	IEC/EN 60068-2-78	Tamb +60 °C, RH 93%, on/off 30/30 min

Test name	Reference	Test conditions
Random mechanical vibration (non-operational)	JESD22-B103	Acc 6 G, f 10-200 Hz, time 10 mins
Mechanical shock (non-operational)	JESD22-B103	Acc 1500 G, pulse 0.5 ms, shocks 6

**Cautions on use during storage, transportation and operation**

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

# Contact details

Philips Fortimo LED SLM Systems

[www.philips.com/fortimo](http://www.philips.com/fortimo)

[www.philips.com/oem](http://www.philips.com/oem)

Or contact your local Philips sales representative.

[www.philips.com/ledmodulesna](http://www.philips.com/ledmodulesna)

or contact your local Philips  
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