Design-in guide

FastFlex LED module Gen 2

September 2013

PHILIPS

Contents

Introduction to this guide

Philips FastFlex LED module 2x8 Gen2

Thank you for choosing the Philips FastFlex LED module Gen2. In this guide you will find all the information required to design this module into a luminaire as well as valuable hints and tips.

Information and support

On our website at www.philips.com/technology, you will not only find information about this module but also design-in guides and CAD files for all Philips LED products.

If you require any further information or support please consult your local Philips office or visit:
www.philips.com/fastflex for all commercial and technical downloads
www.philips.com/xitanium for Xitanium LED drivers
www.philips.com/outdoor for general information on outdoor products

Introduction to the FastFlex LED module Gen2

Figure 1. FastFlex LED module 2x8 Gen2

Figure 2. FastFlex LED board 2x8 Gen2

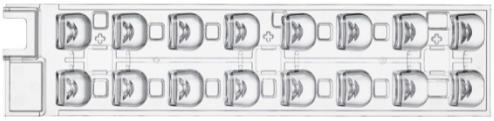


Figure 3. FastFlex LED lens 2x8/IV-X Gen2

Figure 4. FastFlex module clips

Figure 5. Cable Fortimo 7PA to 6wire - 60 mm

Applications

The Philips FastFlex LED module has been developed primarily for outdoor applications but can also be used indoors (providing the applicable IEC regulations are observed and all design-in requirements are met).

Product description

To operate a system you will need the following products, which are sold separately:

- One or more FastFlex LED modules. Each FastFlex LED module consists of:
- FastFlex LED board 2x8 Gen2 (any type, Table 1)
- FastFlex lens 2x8 Gen2 (any type, Table 1)
- FastFlex module clips (3 pieces are necessary for 1 FastFlex LED board)
- Compatible Xitanium LED driver, Tables 2 to 7
- Specified cables, Tables 2 to 7

Classification

The FastFlex LED module Gen2 with Xitanium driver can be used in:

- Class I and Class II IEC isolation systems
- Non-Class 2 UL systems

IMPORTANT USAGE NOTES

- Minimum drive current = 100 mA. If dimmed below 100 mA, Philips does not guarantee the specified product performance
- Maximum drive current = 1,000 mA. This limit must be observed in all cases, including CLO
- T_{case} must not exceed 75 °C, regardless of drive current
- ΔT ($T_{ambient}$ -T_{case}) must not exceed 50 °C, regardless of drive current
- Xitanium LED driver will dim the modules if total output power exceeds the driver's maximum output power
- Failure to comply with usage conditions will void product warranty

The FastFlex LED module system components

Table 1. FastFlex LED module components

Product	GPC	EOC
FastFlex LED board 2x8/740 Gen2	929000873706	871829170555000
FastFlex LED board 2x8/840 Gen2	929000873606	871829170553600
FastFlex lens 2x8/II-X Gen2	929000873806	871829170795000
FastFlex lens 2x8/III-X Gen2	929000873906	871829170797400
FastFlex lens 2x8/IV-X Gen2	929000874006	871829170799800
FastFlex lens 2x8/V Gen2	929000874106	871829170801800
FastFlex module clip	929000810003	871829122435800
Cable Fortimo 7PA to 6wire - 600 mm	929000803903	871829121412000

NB.
Assembling 1 FastFlex LED module requires 3 FastFlex module clips. Please multiply the quantity of modules by 3 when placing the order for clips.

FastFlex LED system with Xitanium LED drivers, Class II

FastFlex LED modules are advised to be used in combination with Xitanium LED Xtreme drivers. Approved Class II system combinations are shown in Tables 2-5.

FastFlex LED system with Xitanium Programmable LED drivers

IMPORTANT NOTE!
Maximum driver output current is defined at $T_{ambient}$ = 25 °C and ΔT 50 °C. Tolerances of ±5% can apply. At lower ambient temperatures the maximum current may need to be programmed to a lower value. The driver will automatically dim the modules if total output power exceeds the driver's maximum output power.

Table 2. FastFlex LED system with Xitanium Programmable LED drivers, Class II compliant

Number of FastFlex LED modules (any type)	Max output current[1] (mA)	Driver	GPC	Cable
1x	530	Xitanium 40W 0.53A Prog+ GL-J sXt	929000710303	Cable Fortimo 7PA to 6wire - 600 mm
	700	Xitanium 40W 0.7A Prog+ GL-J sXt	929000708803	
	1000	Xitanium 75W 0.1 – 1.05A Prog+ sXt	929000708903	
2x	700	Xitanium 75W 0.70A Prog+ GL-Z sXt	929000710103	2x Cable Fortimo 7PA to 6wire - 600 mm
	700	Xitanium 75W 0.35-0.7A GL Prog sXt	929000702302	
	700	Xitanium 75W 0.35-0.7A GL Prog+ sXt	929000704903	
	1000	Xitanium 150W 0.1-1.05A Prog+ sXt	929000709003	
3x	530	Xitanium 75W 0.35-0.7A GL Prog sXt	929000702302	3x Cable Fortimo 7PA to 6wire - 600 mm
	530	Xitanium 75W 0.35-0.7A GL Prog+ sXt	929000704903	
	530	Xitanium 100W 0.53A Prog+ GL-Z sXt	929000710403	
	700	Xitanium 150W 0.7A Prog+ 230V-H sXt	929000710503	
4x	700	Xitanium 150W 0.7A Prog+ 230V-H sXt	929000710503	4x Cable Fortimo 7PA to 6wire - 600 mm
	700	Xitanium 150W 0.35-0.7A GL Prog sXt	929000702202	
	700	Xitanium 150W 0.35-0.7A GL Prog+ sXt	929000705103	
5x	610[1]	Xitanium 150W 0.7A Prog+ 230V-H sXt	929000710503	5x Cable Fortimo 7PA to 6wire - 600 mm
	610[1]	Xitanium 150W 0.35-0.7A GL Prog sXt	929000702202	
	610[1]	Xitanium 150W 0.35-0.7A GL Prog+ sXt	929000705103	

[1]Max output current is defined at $T_{ambient}$ = 25 °C and ΔT 50 °C. See IMPORTANT NOTE above.

FastFlex LED system with dimmable, adjustable-output-current Xitanium AOCM LED drivers

Table 3. FastFlex LED system with Xitanium AOCM LED drivers, Class II compliant

Number of FastFlex LED modules (any type)	Max output current (mA)	Driver	GPC	Cable
2x	530	Xitanium 75W 0.53A AOCM 1-10 230V-Y sXt	929000712403	2x Cable Fortimo 7PA to 6wire - 600 mm
	700	Xitanium 75W 0.70A AOCM 1-10 GL-Y sXt	929000708003	

FastFlex LED system with dimmable single-output-current Xitanium LED drivers

Table 4. FastFlex LED system with Xitanium dimmable single-output-current LED drivers, Class II compliant

Number of FastFlex LED modules (any type)	Max output current (mA)	Driver	GPC	Cable
1x	700	Xitanium 75W 0.70A 1-10V 230V sXt	929000705503	Cable Fortimo 7PA to 6wire - 600 mm
	1000	Xitanium 150W 1.05A 1-10V 230V sXt	929000704712	
2x	700	Xitanium 75W 0.70A 1-10V 230V sXt	929000705503	2x Cable Fortimo 7PA to 6wire - 600 mm
	1000	Xitanium 150W 1.05A 1-10V 230V sXt	929000704712	
	700	Xitanium 150W 0.70A 1-10V 230V sXt	913701211603	
3x	700	Xitanium 150W 0.70A 1-10V 230V sXt	913701211603	3x Cable Fortimo 7PA to 6wire - 600 mm
4x	700	Xitanium 150W 0.70A 1-10V 230V sXt	913701211603	4x Cable Fortimo 7PA to 6wire - 600 mm

FastFlex LED system with fixed Xitanium LED drivers

Table 5. FastFlex LED system with fixed Xitanium LED drivers, Class II compliant

Number of FastFlex LED modules (any type)	Max output current (mA)	Driver	GPC	Cable
2x	700	Xitanium 150W 0.70A 230V sXt	913710859002	2x Cable Fortimo 7PA to 6wire - 600 mm
3x	700	Xitanium 150W 0.70A 230V sXt	913710859002	3x Cable Fortimo 7PA to 6wire - 600 mm
4x	700	Xitanium 150W 0.70A 230V sXt	913710859002	4x Cable Fortimo 7PA to 6wire - 600 mm

FastFlex LED system with Xitanium LED drivers, Class I

FastFlex LED module combinations with certain Xitanium LED drivers may be operated Class I luminaires only.

Approved Class I system combinations are shown in Tables 6 and 7. To use these FastFlex LED systems in Class II luminaires, an additional isolation layer, e.g. kapton foil, must be added during luminaire assembly between the module and mounting surface.

Table 6. FastFlex LED system with Xitanium dimmable single-output-current LED drivers, Class I compliant

Number of FastFlex LED modules (any type)	Max output current (mA)	Driver	GPC	Cable
4x	350	Xitanium 150W 0.35A 1-10V 230V sXt	913701218202	4x Cable Fortimo 7PA to 6wire - 600 mm
5x	350	Xitanium 150W 0.35A 1-10V 230V sXt	913701218202	5x Cable Fortimo 7PA to 6wire - 600 mm

Table 7. FastFlex LED system with fixed Xitanium LED drivers, Class I compliant

Number of FastFlex LED modules (any type)	Max output current (mA)	Driver	GPC	Cable
4x	350	Xitanium 150W 0.35A 230V sXt	913710850002	4x Cable Fortimo 7PA to 6wire - 600 mm
5x	350	Xitanium 150W 0.35A 230V sXt	913710850002	5x Cable Fortimo 7PA to 6wire - 600 mm

As the Xitanium LED driver portfolio is always expanding to include new products, please visit www.philips.com/fastflex or contact your Philips sales representatives for the latest system combinations.

Performance specification

The following paragraphs contain the performance specifications of the FastFlex LED module Gen2.

Typical operating conditions

Table 8. Typical operating conditions

Item	Symbol	Unit	Value	Description
Default output current	If	mA	530	Current setting via Rset1 or Rset2 connection
Case temperature	Tcase	°C	75	Case temperature: typical temperature at which the module operates within specs
Ambient temperature	Tamb	°C	25	Ambient temperature outside luminaire
Driver current	Idriver	mA	530	Driver current used to operate the LED module for typical performance specification

Note:

- ±10% tolerance applies to module flux specifications
- Philips maintains a tolerance of ±6.5% on luminous flux measurements, ±0.06 V on forward voltage measurements, ±2 on CRI measurements and ±5% on CCT measurements

Performance specifications FastFlex LED board 2x8/740 Gen2

All of the following lumen output specifications include optical losses due to the lens (approximately 4%).

FastFlex LED board 2x8 /740 Gen2 performance at Rset (530mA) and T_{case} = 75 °C

Table 9. Performance specification of the Philips FastFlex LED board 2x8 /740 Gen2 under typical operating conditions (If = 530 mA and Tcase = 75 °C).

Item	Min	Typ	Max	Unit
Initial lumen output	2732	3036	3339	lm
Initial efficacy	109	129		lm/W
Forward voltage	-	44.4	47.2	V
Initial power consumption	21	23.5	25	W
Correlated Color Temperature (CCT)	-	4000	-	K
Color Rendering Index (CRI)	70		-	R_a
Initial color accuracy	-	5	7	SDCM
Lumen maintenance B50L70	-	>50,000	-	hrs
Product lifetime, 90% survivals	-	50,000	-	hrs

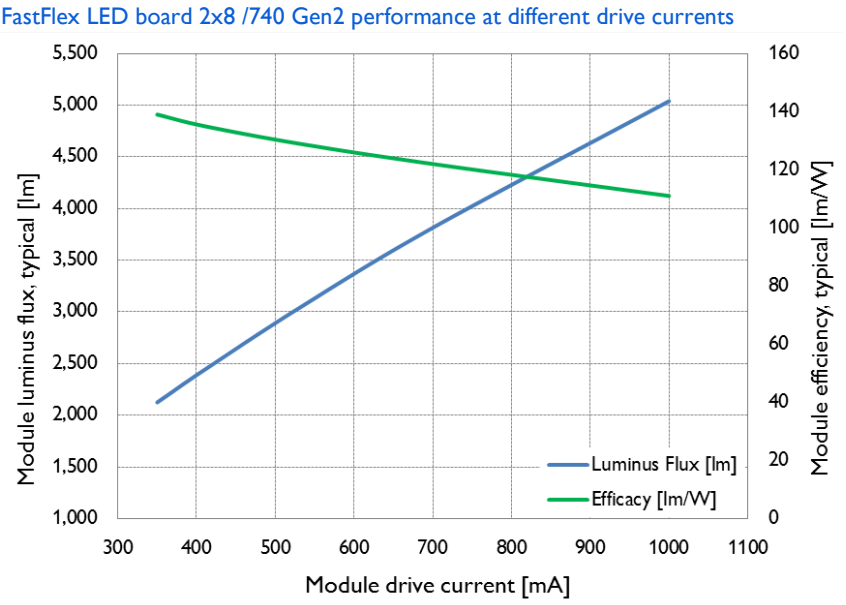


Figure 6. Typical lumen output and efficiency of FastFlex LED board 2x8/740 Gen2; T_{case} = 75 °C, including lens-related optical losses of 4%. (This curve is based on an extrapolation; actual measurements in Table 8 are leading.)

Table 10. Predicted performance specification of the Philips FastFlex LED board 2x8/740 Gen2 at various current settings including 4% optical losses.

Drive current (mA)	Luminous flux, min (lm)	Luminous flux, typical (lm)	Efficacy, min (lm/W)	Efficacy, typical (lm/W)	Thermal power, typical (W)	Power, typical (W)	Power, max (W)
350	1911	2124	117	139	9.2	15.3	16.4
410	2195	2439	114	135	10.9	18	19.3
530	2732	3036	109	129	14.6	23.5	25.1
700	3432	3814	102	122	20.1	31.3	33.5
1000	4535	5039	94	111	30.9	45.4	48.5

Performance specifications FastFlex LED board 2x8/840 Gen2

All of the following lumen output specifications include optical losses due to the lens (approximately 4%).

FastFlex LED board 2x8 /840 Gen2 performance at Rset (530mA) and T_{case} = 75 °C

Table 11. Performance specification of the Philips FastFlex LED board 2x8 /840 Gen2 under typical operating conditions (If = 530 mA and Tcase = 75 °C).

Item	Min	Typ	Max	Unit
Initial lumen output	2583	2870	3157	lm
Initial efficacy	103	122		lm/W
Forward voltage	-	44.4	47.2	V
Initial power consumption	21	23.5	25	W
Correlated color temperature (CCT)	-	4000	-	K
Color Rendering Index (CRI)	80		-	R_a
Initial color accuracy	-	5	7	SDCM
Lumen maintenance B50L70	-	>50,000	-	hrs
Product lifetime, 90% survivals	-	50,000	-	hrs

FastFlex LED board 2x8/840 Gen2 performance at different drive currents

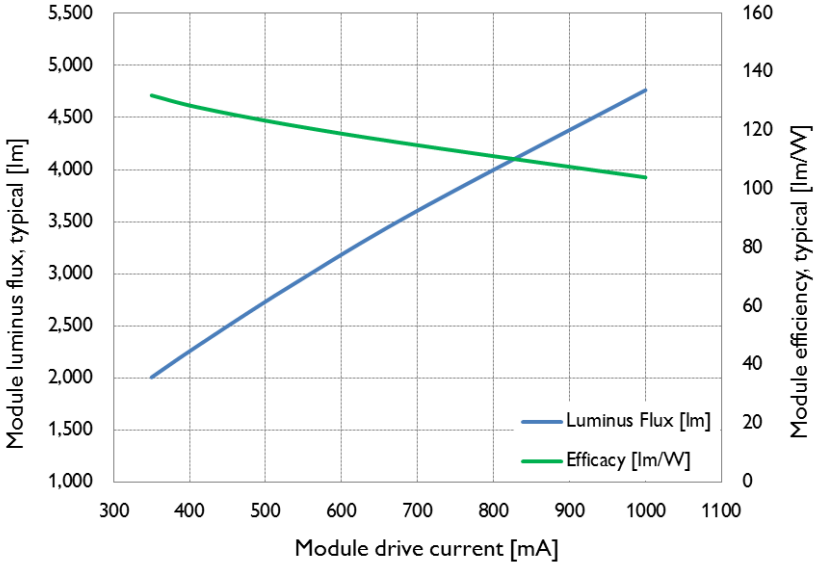


Figure 7. Typical lumen output and efficiency FastFlex LED board 2x8/840 Gen2; T_{case} = 75 °C, including lens-related optical losses of 4%. (This curve is based on an extrapolation, actual measurements in Table 10 are leading)

Table 12. Predicted performance specification of the Philips FastFlex LED board 2x8/740 Gen2 at various current settings including 4% optical losses.

Drive current (mA)	Luminous flux, min (lm)	Luminous flux, typical (lm)	Efficacy, min (lm/W)	Efficacy, typical (lm/W)	Thermal power, typical (W)	Power, typical (W)	Power, max (W)
350	1806	2006	110	132	9.4	15.2	16.4
410	2075	2305	107	128	11.3	18.0	19.3
530	2583	2870	103	122	15.0	23.4	25.1
700	3246	3606	97	115	20.7	31.4	33.5
1000	4287	4763	88	104	32.0	45.7	48.5

Optical distributions

Figure 8. FastFlex LED board 2x8/740 Gen2

Optical performance of FastFlex LED board 2x8 Gen2

N.B.
Optical efficiency of the complete FastFlex LED module Gen2, pre-assembled with the FastFlex lens Gen2 (any type) is specified as 96% ±1%.

FastFlex lens 2x8 Gen2 (any type) is optically backwards compatible with Gen1 board.

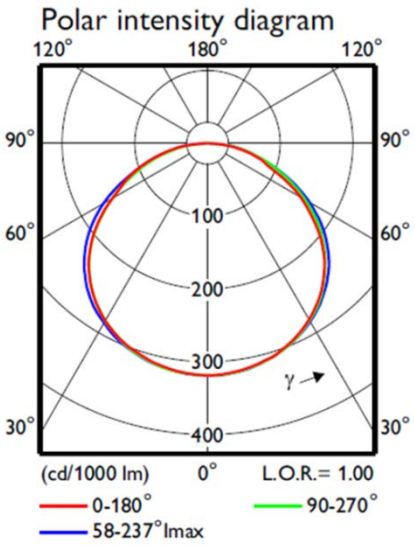
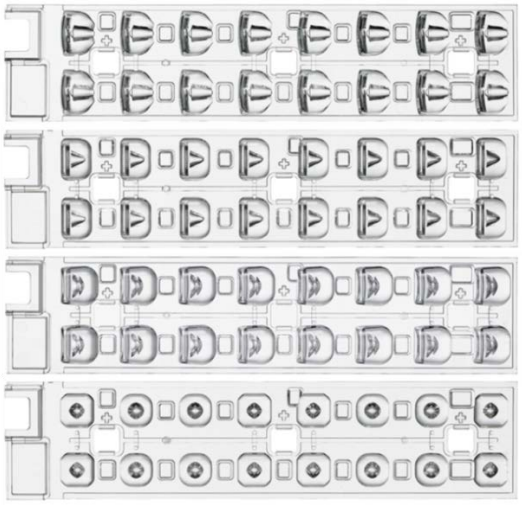


Figure 9. FastFlex LED board polar intensity diagram (no lens)

Optical performance of FastFlex lens 2x8 Gen2

FastFlex lens 2x8 Gen2 (any type) is optical backwards compatible with Gen1 board.



FastFlex lens 2x8/II-X

FastFlex lens 2x8/III-X

FastFlex lens 2x8/IV-X

FastFlex lens 2x8/V

Figure 10. FastFlex lens 2x8, different types

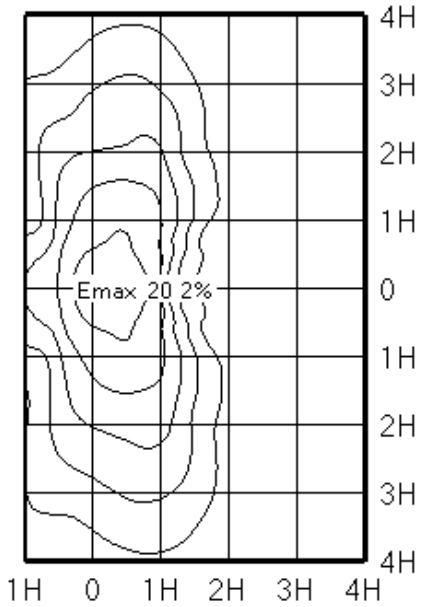


Figure 11. Isolux diagram, FastFlex LED module with FastFlex lens 2x8/II-X Gen2

FastFlex lens 2x8/II-X Gen2

FastFlex lens 2x8/II-X is designed for narrow roads and urban street lighting.

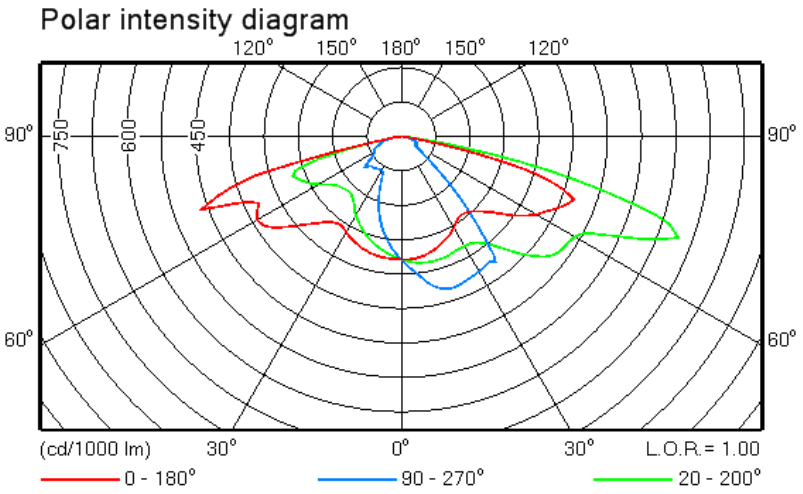


Figure 12. Polar intensity diagram, FastFlex LED module with FastFlex lens 2x8/II-X Gen2

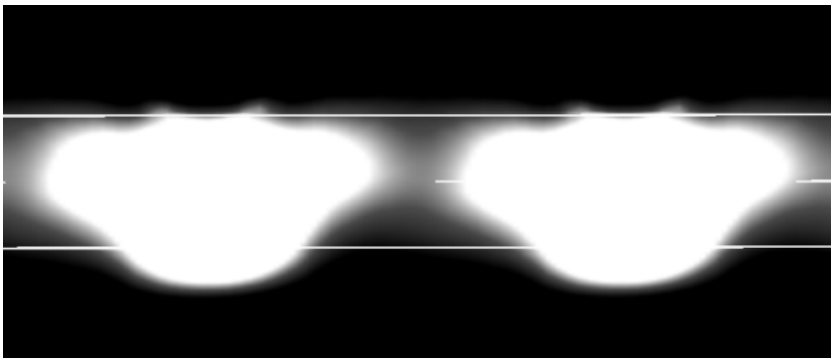


Figure 13. Application rendering, FastFlex LED module with FastFlex lens 2x8/II-X Gen2

FastFlex lens 2x8/III-X Gen2

FastFlex lens 2x8/III-X is designed for roads of medium width and urban street lighting.

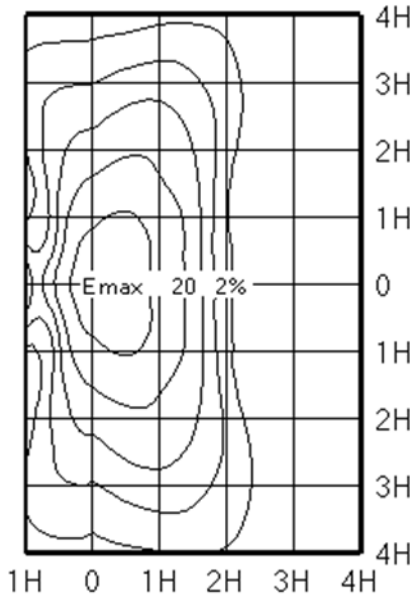


Figure 14. Isolux diagram, FastFlex LED module with FastFlex lens 2x8/III-X Gen2

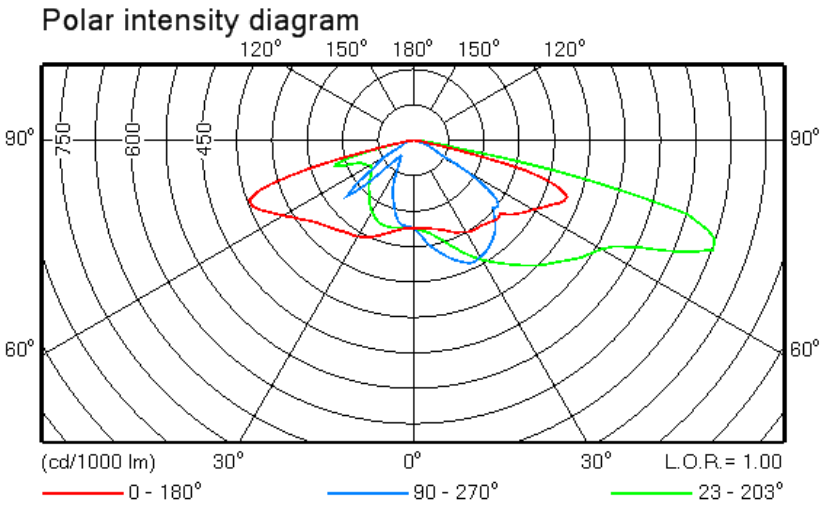


Figure 15. Polar intensity diagram, FastFlex LED module with FastFlex lens 2x8/III-X Gen2

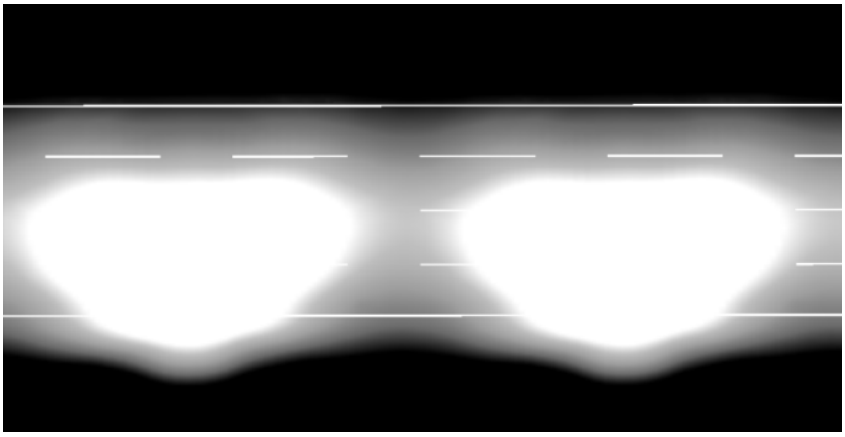


Figure 16. Application rendering, FastFlex LED module with FastFlex lens 2x8/III-X Gen2

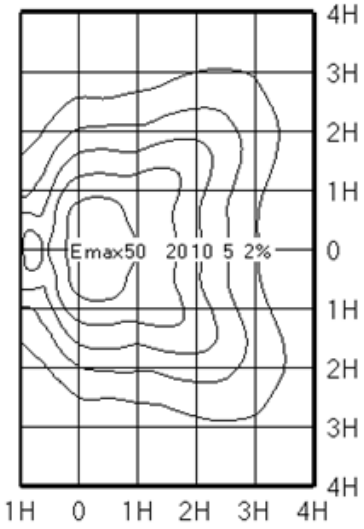


Figure 17. Isolux diagram, FastFlex LED module with FastFlex lens 2x8/IV-X Gen2

FastFlex lens 2x8/IV-X Gen2

FastFlex lens 2x8/IV-X is designed for wide roads and asymmetrical floodlighting.

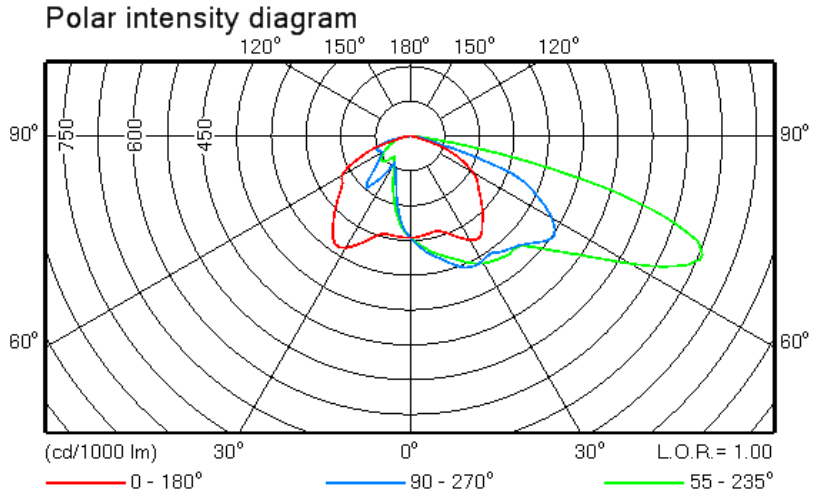


Figure 18. Polar intensity diagram, FastFlex LED module with FastFlex lens 2x8/IV-X Gen2

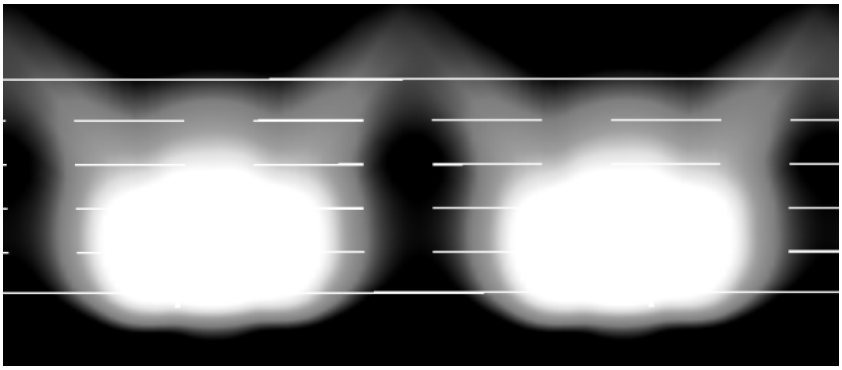


Figure 19. Application rendering, FastFlex LED module with FastFlex lens 2x8/IV-X Gen2

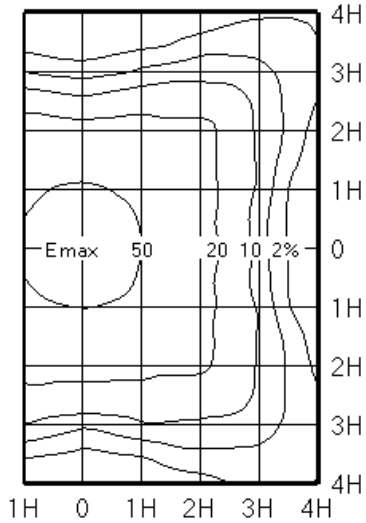


Figure 20. Isolux diagram, FastFlex LED module with FastFlex lens 2x8/V Gen2

FastFlex lens 2x8/V Gen2

FastFlex lens 2x8/V is designed for symmetrical lighting, e.g. high bays, parking lots, petrol stations.

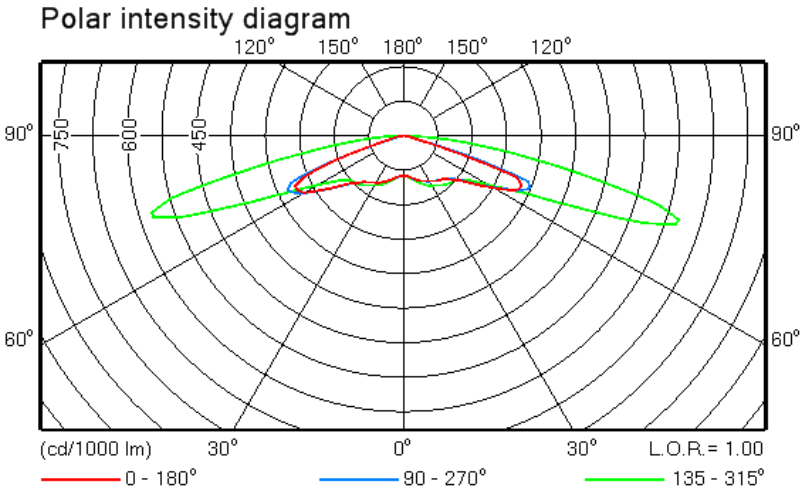


Figure 21. Polar intensity diagram, FastFlex LED module with FastFlex lens 2x8/V Gen2

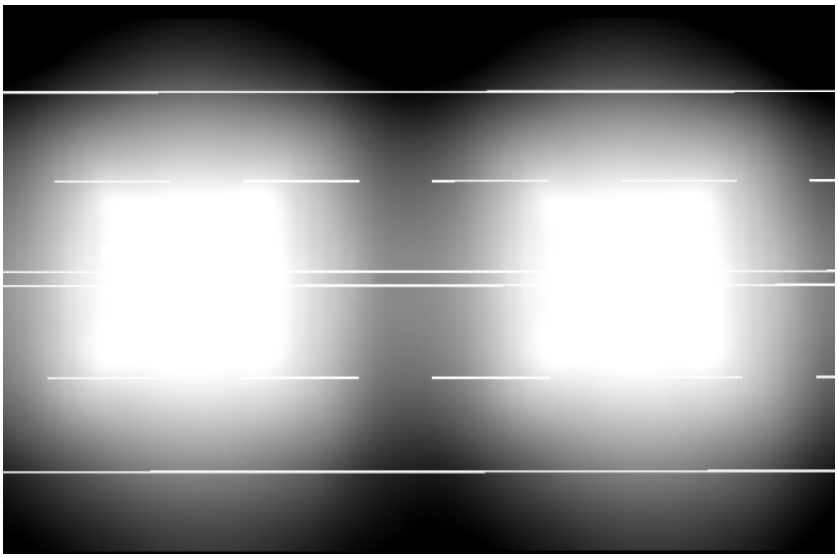


Figure 22. Application rendering, FastFlex LED module with FastFlex lens 2x8/V Gen2

N.B.

- Component and process tolerances can result in imperfectly symmetrical light distributions. Maximum acceptable tolerances will have minimal impact on optical distributions and optical performance in the final application for a variety of reasons (e.g. light from neighboring poles, flux differences < 20% not visible for the human eye).
- All polar intensity diagram illustrations are just an indication of the beam shape. We suggest making use of the IES files available on the FastFlex LED module website.

Lighting characteristics

Light distribution

FastFlex LED module is suitable for a variety of applications, including urban street, road and industrial lighting.
Please refer to the *Product Datasheet* section for the specific optical performance of the FastFlex LED board and FastFlex lenses.

Optical files

Optical files can be downloaded from the FastFlex LED module website at www.philips.com/fastflex in the IES format.

Photometric files such as IES and LDT can be used to check the far-field intensity distribution of the FastFlex LED module. The final design could be verified using a simulation performed with a ray set for the FastFlex LED module with the appropriate lens.

Spectral light distribution

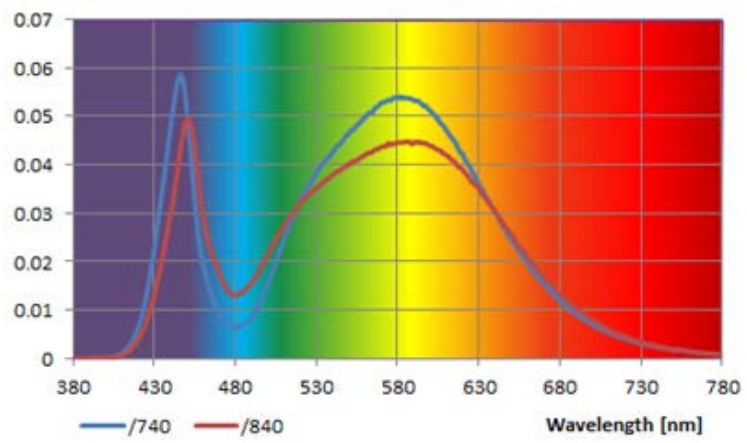


Figure 23. Spectral light distribution for the FastFlex board 2x8 Gen2 4000 K CRI 70 and CRI 80

Color consistency (SDCM)

The color consistency of FastFlex LED boards is specified as <7 SDCM over the product's lifetime. Typical color consistency is specified as <5 SDCM. SDCM stands for Standard Deviation of Color Matching and the value 5 refers to the size of an ellipse around the specified target point.

Figure 24 shows the color target for both CRI 70 and CRI 80 FastFlex 2x8 board Gen2. The color target is specified for the operating conditions T_{case} = 75 °C, $T_{ambient}$ = 25 °C and at 530 mA.

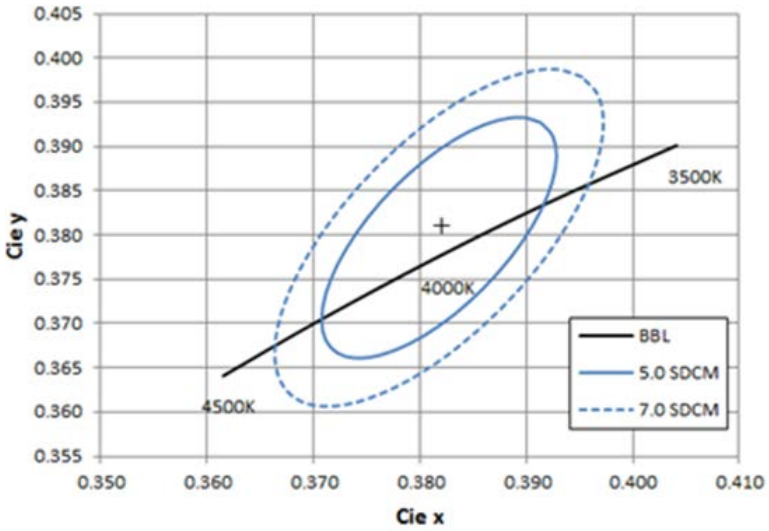


Figure 24. Color consistency FastFlex LED board Gen2

Starting characteristics

After the driver has been started or re-started, the module will produce the intended amount of light immediately

Lifetime characteristics

FastFlex LED module has an expected lifetime of 50,000 burning hours with 90% survivals (critical failures)

Specified lifetime performance

Figures 25-28 show the expected lumen maintenance over a typical product lifetime when FastFlex LED modules are used in a system without the CLO feature.

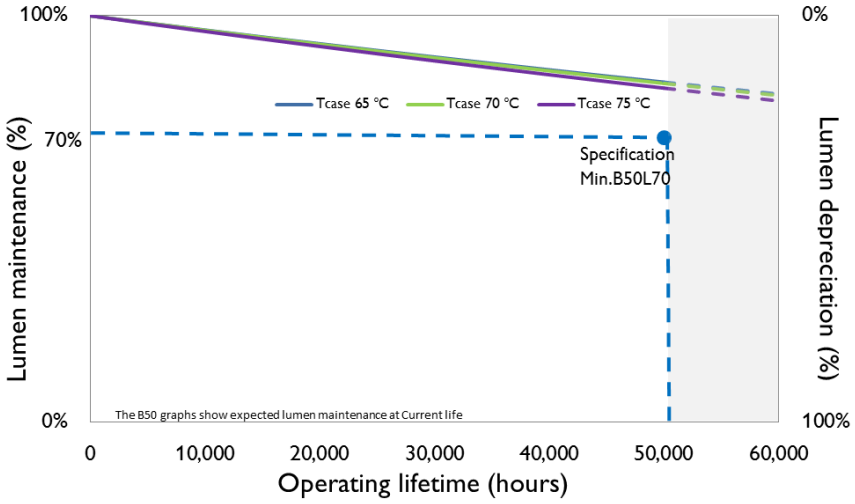


Figure 25. FastFlex LED module B50 lumen maintenance; 530 mA drive current and different T_{case} values

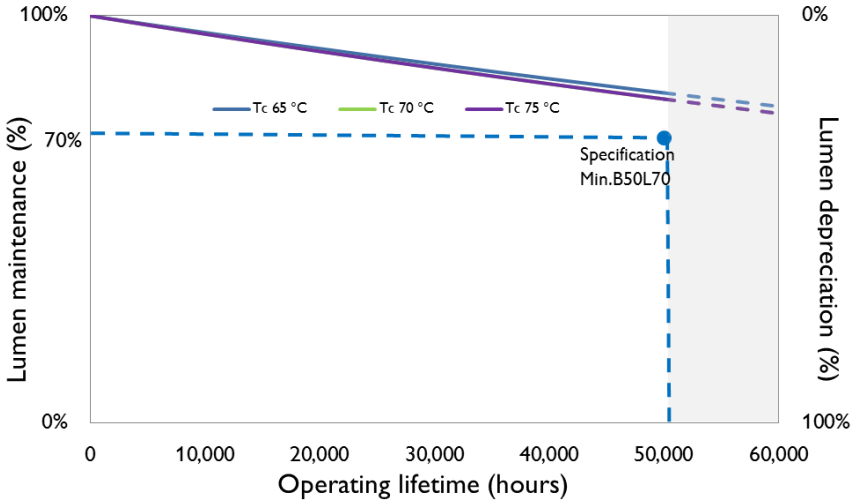


Figure 26. FastFlex LED module B50 lumen maintenance; 1,000 mA drive current and different T_{case} values

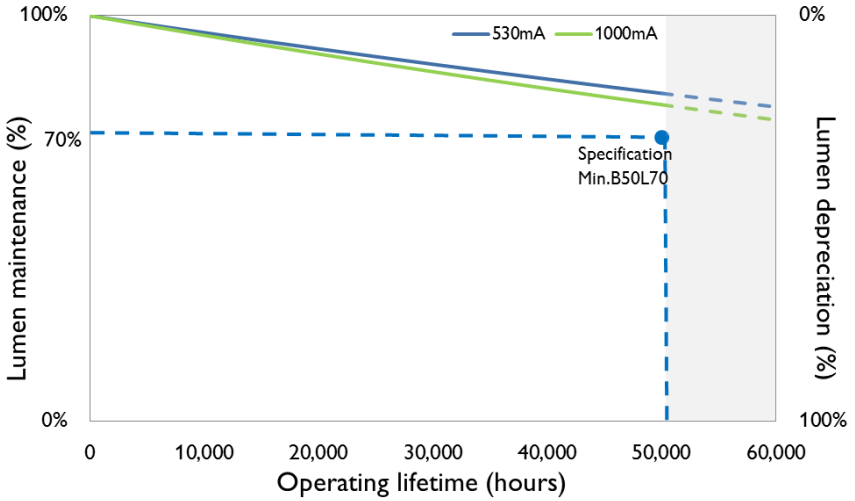


Figure 27. FastFlex LED module B10 lumen maintenance; T_{case} = 75 °C and different drive currents

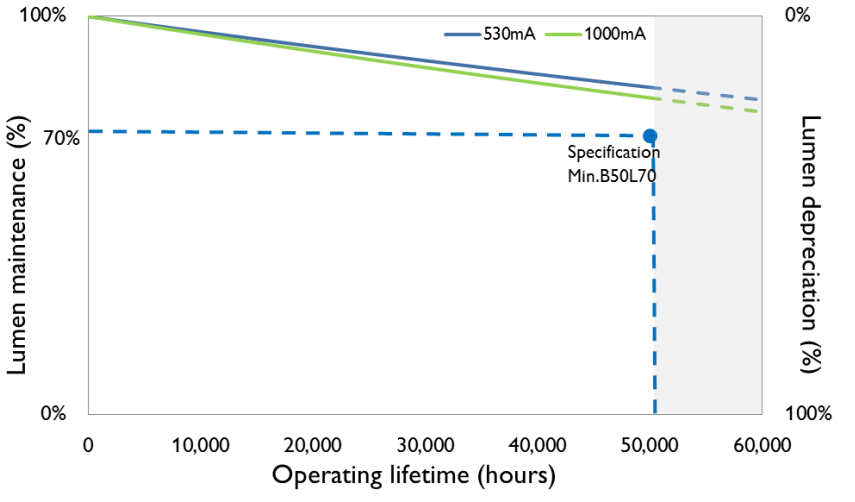


Figure 28. FastFlex LED module B50 lumen maintenance; T_{case} = 75 °C and different drive currents

Product dimensions

FastFlex LED module 2x8 Gen2

FastFlex LED module dimensions are given for reference (mechanical model leading).

Table 13. FastFlex LED module 2x8 dimensions

Dimensions in mm (nominal ±0.4 mm)	A1	A2	A3	A4	A5	A6	A7	B1	B2	B3	C1	C2	C3
FastFlex LED module 2x8 Gen2 (all types)	216	42	75	24	30	175	3.5	49.5	10	25	1.6	7.4	8.5

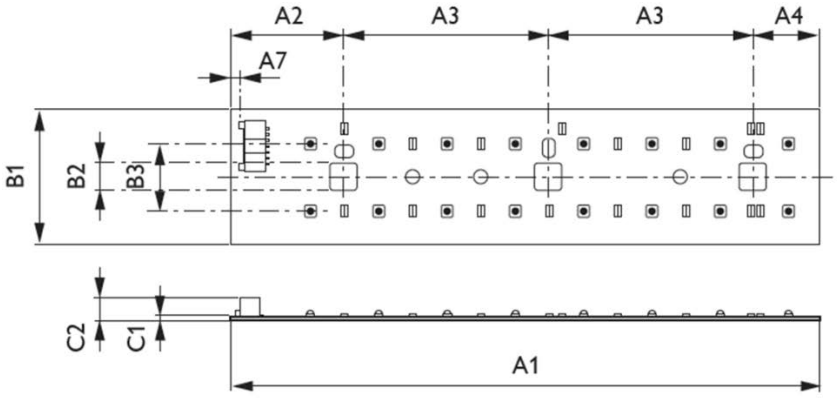


Figure 29. FastFlex LED board 2x8 (any type)

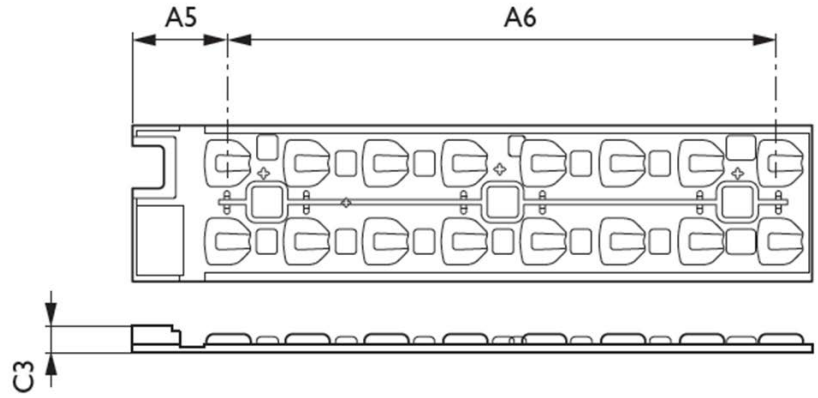


Figure 30. FastFlex lens 2x8 (any type)

Outer dimension step files for the assembled FastFlex LED module are available at www.philips.com/fastflex.

Electrical characteristics

Figure 31. Cable Fortimo 7PA to 6wire - 600 mm

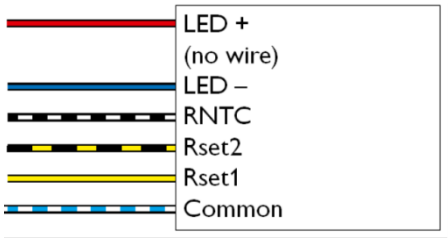


Figure 33. Cable wiring to driver

Connection between module and driver

The FastFlex LED module is compatible with both Rset1 and Rset2 Xitanium LED drivers. Using the Rset on the module with these drives, will provide an output current of 530 mA, and result in the performance and power consumption specified for that current.

We advised to use the FastFlex LED modules in combination with the Xitanium LED drivers mentioned in Tables 2 to 7 (approved combinations).

Cable

FastFlex LED module can be connected to the driver using the cables specified in Tables 2 to 4.

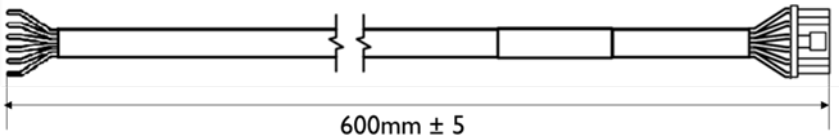


Figure 32. Cable Fortimo 7PA to 6wire - 600 mm (929000803903)

Table 14. Fortimo 7PA to 6wire cable color coding

Connector pin	Function	Color coding driver/cable
Pin 1	LED+	Red
Pin 2	-	No wire
Pin 3	LED -	Blue
Pin 4	RNTC	Black/White
Pin 5	Rset2	Yellow/Black
Pin 6	Rset1	Yellow
Pin 7	Common	Blue /White

Note:
The Rset2 wire should be left unconnected when Rset1 drivers are used, and vice versa.

FastFlex LED board connector pins

Table 15. FastFlex LED board connector pins

Connector	Signal	Description
Pin 1	IDC	LED driver current input
Pin 2	(HV spacer)	Not connected
Pin 3	PGND	Power ground
Pin 4	NTC	Temperature sensor (RNTC) resistor in series
Pin 5	Rset2	Resistor for current setting of LED driver type Rset2
Pin 6	Rset1	Resistor for current setting of LED driver type Rset1
Pin 7	SGND	Signal ground

N.B.
It is possible to connect two or more modules in series to one Xitanium driver by using multiple cables. It is important to note that the driver can only communicate with one of the modules (master/slave), see *Installation instructions*.

Important recommendations and warnings

The following recommendations and warnings should be taken into account when using FastFlex LED modules and Xitanium LED drivers.

IMPORTANT USAGE CONDITIONS

- Minimum drive current = 100 mA. If dimmed below 100 mA, Philips does not guarantee product performance
- Maximum drive current = 1,000 mA. This limit must be observed in all cases, including CLO
- T_{case} must not exceed 75 °C, regardless of drive current
- Failure to comply with usage conditions will void product warranty

Design-in phase

- It is recommended to use the approved Philips Xitanium LED drivers. For a list of approved drivers please see Tables 2 to 7.
- It is mandatory to design the luminaire so it is enclosed in such a way that it can only be opened with special tools (by an electrician) in order to prevent accidental contact with live parts.
- Safety and IEC recommendations: the general IEC recommendations for luminaire design and national safety regulations (ENEC, CE, etc.) also apply to selected FastFlex LED modules and Xitanium LED drivers. Luminaire manufacturers are advised to conform to the international standards for luminaire design (IEC 60598 - Luminaires).
- Do not apply mains power directly to the LED module.
- To prevent damages of the board and or lenses, do not use Gen1 in combination with Gen2 components.

Design-in and manufacturing phase

- Do not use damaged or defective modules.
- Do not drop the LED module or let any object fall onto it as this may damage the module. Do not use the LED module if it has been dropped or an object has fallen onto it and there are visible defects or damage.

Installation and service phase of luminaires

- The luminaire should not be serviced while the mains voltage is connected; this includes connecting or disconnecting the FastFlex LED module cable.
- Hot switching is not allowed.

Controllability

Default dimming protocols

The FastFlex Gen2 LED module is dimmable with a range of integrated light control options.

- Adjustable Output Current
- Constant Light Output
- 1-10 V, AmpDim, DALI and Dynadimmer dimming

Specific features will depend on the Xitanium LED driver system selected (Table 3). Please visit www.philips.com/getincontrol for complete information on the integrated light control options available in the Xitanium product range.

Warning!
Although it is technically possible to dim FastFlex Gen2 LED modules down to 100mA, Philips does not specify product performance for modules operating below this current.

Constant Light Output

There are minimum light level requirements for public lighting. In order to compensate for lumen depreciation, which occurs in all light sources over time, the lighting design is often over-lit at the beginning of the source's lifetime.

It is possible to deliver energy savings by avoiding over-lighting and still ensuring the minimum expected light level over the lifetime of the module if the Constant Light Output (CLO) feature in Xitanium Programmable drivers is used.

The CLO feature uses a predictive algorithm to increase the output current to the module over the specified lifetime of 50,000 hours. As the current increases, so the energy consumption also increases. The CLO feature can be combined with other dimming protocols for even greater energy savings.
Programming CLO ensures stable light levels over the lifetime of the system. Please use Table 14 to program the CLO curve FastFlex modules.

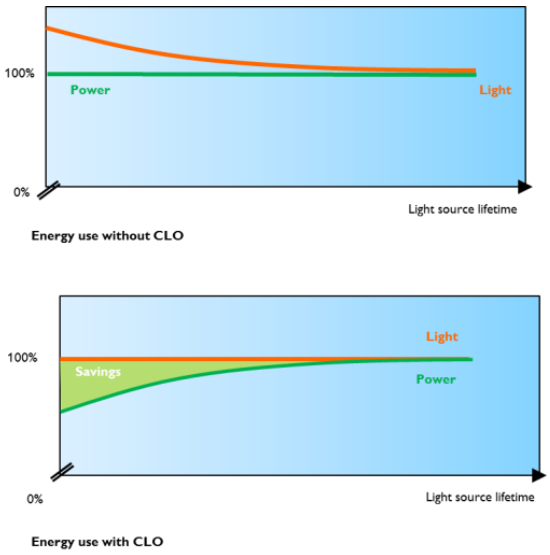


Figure 34. Energy savings with CLO

Example
10,000-lumen FastFlex system with 530 mA initial drive current

- Without CLO, a system designed to produce 10,000 lumens at the start will deliver 8,000 lumens at 50,000 burning hours
- With CLO, a system designed to produce 10,000 lumens at the start will deliver 10,000 lumens at 50,000 burning hours
- CLO feature will increase driver current from 530 mA to 636 mA at 50,000 burning hours
- T_{case} should not exceed 75 °C at 636 mA

Table 16. FastFlex LED module Gen2 LED module CLO curve

Module working hours	Power level
0	100%
5,000	102%
1,0000	104%
15,000	106%
20,000	108%
25,000	110%
30,000	112%
35,000	114%
40,000	116%
45,000	118%
50,000	120%

N.B.

- Programming CLO increases the thermal load over the lifetime of the module (see *Example* below)
- Thermal management needs to ensure T_{case} at end-of-life current does not exceed 75 °C
- To calculate expected drive current at 50,000 burning hours, please refer to Table 8
- CLO current at end-of-life drive current must not exceed maximum specified current

Controlling FastFlex LED module Gen2 with Xitanium LED drivers

Xitanium LED drivers allow the use of several control protocols, including 1-10 V, DALI, Integrated Dynadimmer and CLO. FastFlex LED modules can be used with both Rset1 and Rset2 LED drivers.

Further details on programming can be found in the Design-in guide for Xitanium LED Programmable Drivers. The Design-in guide can be downloaded via our website at www.philips.com/xitanium

Which Philips controls can be used?

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

Thermal management

The critical thermal management points for the module and driver are set out in this chapter in order to facilitate the design-in of the Philips FastFlex LED module. Keeping these thermal points in mind will help to ensure the optimal performance and lifetime of the system.

Thermal specifications

The main thermal specification that needs to be taken into account when designing in the FastFlex LED module is the T_{case} temperature. The Tcase must never exceed $T_{case,max}$ tested in a draft-free lab environment at 25 °C, under all drive current conditions up to 1,000 mA.

Table 17. Thermal rating of the system

Item	Description	Symbol	Unit	Max value
Case temperature	Temperature at which the module operates within specifications	T_{case}	°C	75
Delta T	The maximum temperature difference between Tambient and Tcase	ΔT	°C	50

The thermal requirement for the cooling solution per FastFlex LED module is represented graphically in Figure 35. The Rth values are based on actual thermal power per FastFlex LED module.

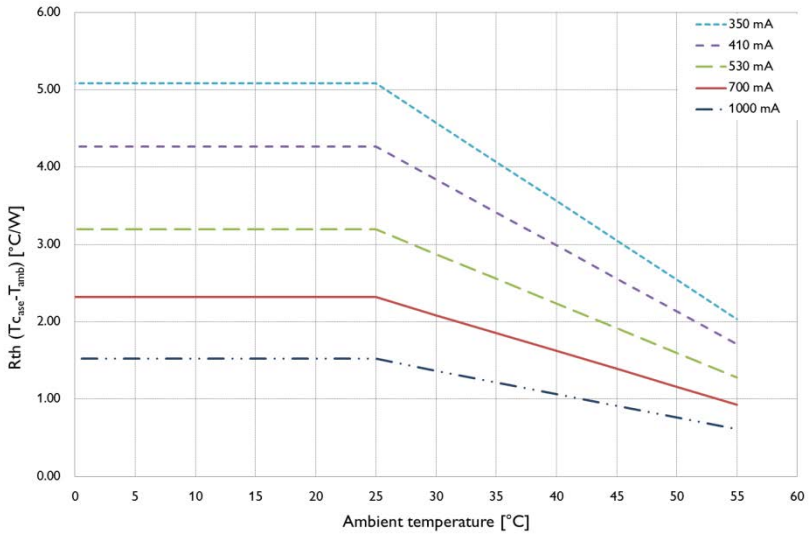


Figure 35. Rth requirement for FastFlex LED board in degrees per watt

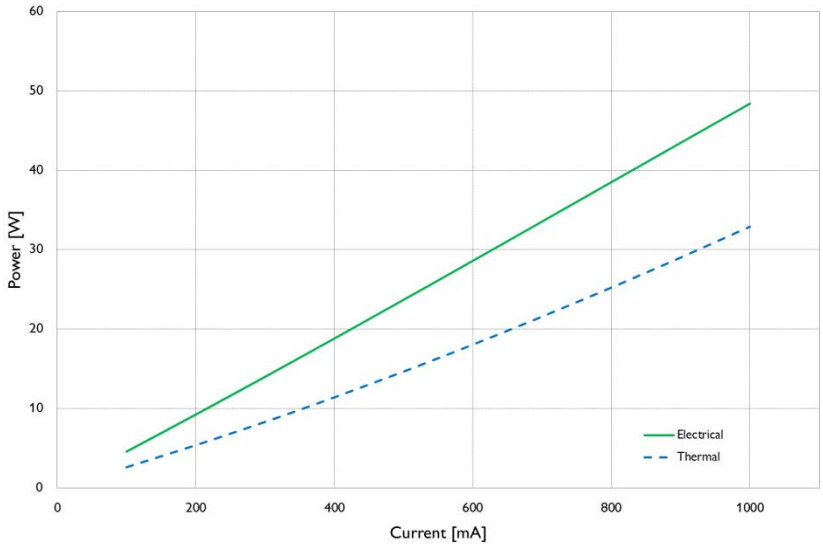


Figure 36. Heat dissipation vs. drive current

Operating temperature

Definitions

- *Module temperature*: temperature measured at the specified T_{case} point (at the base) of the module
- *Driver temperature*: temperature measured at the specified T_{case} point on the driver
- *Ambient temperature*: temperature of the air surrounding the luminaire in the test environment or application
- *Ambient temperature in a lab environment*: air temperature in a testing area, in a controlled environment free from drafts
- *Average ambient temperature*: monthly average temperature based on at least 2 measurements per day, with at least 8-hour intervals between measurements

Module temperature

To achieve typical product lifetime characteristics, it is crucial to ensure that the product is operating within the specified temperature limits. These limits are determined not only by the product and the application, but also by the luminaire design and ambient environment.

Warning!

- Maximum T_{case} should never exceed specified T_{case} max
- Thermal design should ensure that module T_{case} <75 °C
- Thermal design should ensure that driver T_{case} < max specified driver T_{case}
- Thermal design must ensure maximum ΔT ($T_{case} - T_{amb}$) ≤50 °C

Thermal de-rating

The FastFlex LED board contains a thermal de-rating system to detect overheating and extreme lifetime degradation of the LEDs when operated outside the maximum permitted environmental conditions. Such conditions can be caused by extreme ambient conditions or inadequate heat management design. The thermal de-rating is based on temperature detection on the FastFlex LED board. When multiple modules are connected to 1 driver, one module is in the "master" mode and the others are in the "slave" mode. It is strongly recommend that the information is read out from the module with the highest T_{case} in the application.

When the FastFlex LED board is used in combination with Xitanium LED Programmable drivers, the default driver profile will ensure the correct Module

Temperature Protection (MTP) settings.

Warning!
MPT is only a failsafe in order to protect the module against overheating during peaks in ambient temperature or in the event of a faulty heat sink design. Optimum performance will only be achieved if the T_{case} stays below 75 °C at the specified maximum ambient temperature, measured according to the procedure described above.

Thermal measurements

The maximum ambient temperature at which the luminaire will operate constitutes the initial key criterion for defining the correct temperature limit and validating the thermal luminaire design.

If the maximum ambient temperature ($T_{amb,max}$) is 25 °C or lower, the luminaire design needs to ensure that the module temperature does not exceed 75 °C when tested in a lab environment at 25 °C ambient.

When $T_{amb,max}$ exceeds 25 °C during module operating hours, the maximum T_{case} specified is 75 °C, tested in a lab environment at $T_{amb,max}$.

Note: The ambient temperatures given above are average temperatures during the operational period of the module.

Critical temperature point (T_{case})

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 FastFlex LED board at its critical temperature point, see Figure 37.
If the case temperature at the T_{case} point exceeds the recommended T_{case} max, this will have an adverse effect on the performance of the LEDs and the FastFlex LED module in terms of light output, lifetime and lumen maintenance.

Measurement of critical temperature point

On the back of the module there is a T_{case} (Tc) point, which should be used for all temperature measurements. The maximum temperature of the module should be measured at a point in the center of the bottom of the LED board, see Figure 16.
The temperature must be stable before any reliable data can be obtained (depending on the size and material of the luminaire, this will take between 30 and 180 minutes).

N.B.
It is important that the T_{case} point is free of thermal interface material when the thermocouple is connected so that temperature measurements can be taken.

It is essential to have a stable connection between the thermocouple and the module. Any shifting of the thermocouple will result in measurement errors and poor measurement repeatability.

The T_{case} should be measured at its critical temperature point using a thermocouple on the base of the LED board. One of the following methods should be used to measure the temperature.

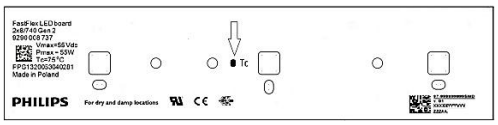


Figure 37. Tc point on FastFlex LED board

1. Preferred method: via a groove in the module mounting surface

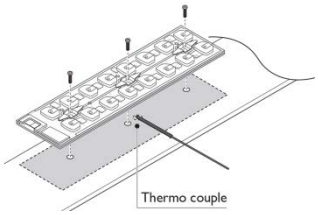


Figure 38. T_{case} measurement via thermocouple in a groove

2. Via an access point cut through the mounting surface of the module

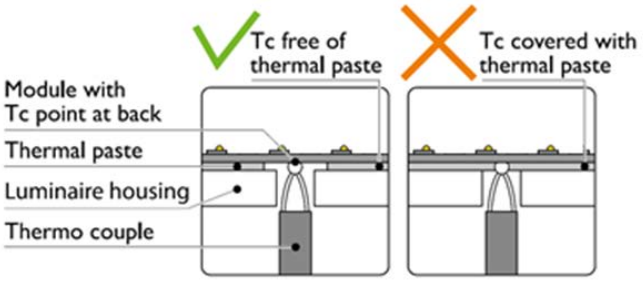


Figure 39. T_{case} measurement via an access point in the heat sink

N.B.
In order to ensure accurate T_{case} test results, the case temperature should not vary by more than 1 °C for a period of at least 30 minutes.

Critical module temperature with respect to CLO

The FastFlex LED module can be used with Xitanium Programmable LED drivers with a Constant Light Output (CLO) feature. Over the system lifetime the driver will automatically increase the output current to compensate for lumen depreciation and to keep light levels constant. For the thermal design it is important to ensure that the T_{case} temperature and drive current do not exceed their maximum ratings at end of life. Please refer to the *Constant Light Output* section for details.

Heat sink design

The FastFlex LED module is primarily designed for metal luminaires in which the luminaire housing may double as the heat sink.

Below an indication is given of the required effective cooling area per FastFlex LED board used according to the drive current. The thermal dissipation also increases with increasing drive current, as does the required cooling area.

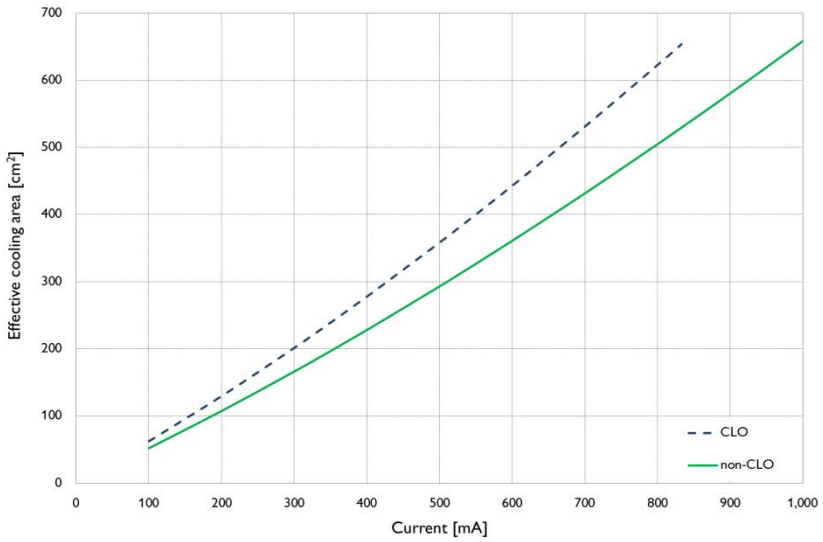


Figure 40. Estimated cooling area as a result of the drive current, with and without CLO

Figure 40 shows the required cooling area (both with and without CLO functionality enabled). With CLO feature, the heat sink needs to be larger to make provision for the increase in output current over lifetime.

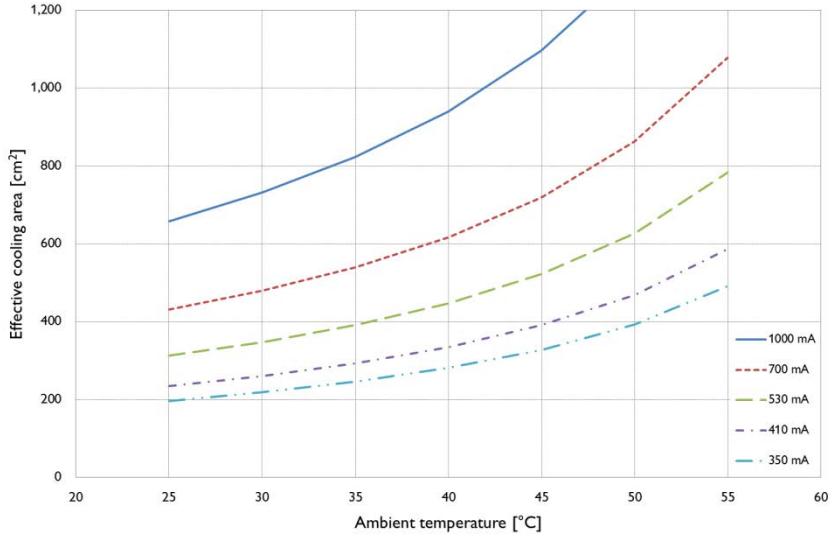


Figure 41. Impact of ambient temperature and drive current on the effective cooling area

Heat sink material

The type of material used has a significant influence on the final result. For example, a comparison of the thermal conductivity (k) of copper with that of corrosion-resistant steel (see Table 8) shows that a substantially smaller heat sink can be made with copper. The best material for heat sink is (soft) aluminum. The thickness (H) of the heat sink is also of major importance. If identical heat sinks made from different materials were used, a similar effect would be achieved with 1 mm copper, 2 mm aluminum, 4 mm brass, 8 mm steel and 26 mm corrosion-resistant steel.

Table 18. Thermal conductivity

Material	W/mK
Copper	400
Aluminum	200
Brass	100
Steel	50
Corrosion-resistant steel	15

Thermal radiation and emissivity coefficient

Thermal radiation accounts for a substantial part of the total heat transfer. The amount of thermal radiation is highly dependent on the emissivity coefficient of the surface. For example, a polished aluminum surface has a very low emissivity coefficient, while a painted surface has a very high one. A higher emissivity coefficient means more effective heat transfer.

Table 19. Thermal emissivity coefficients of common materials

Material	Finish	Emissivity coefficient
Aluminum	New/polished Blank Anodized	0.04 - 0.06 0.20 - 0.30 0.80 - 0.95
Steel	New/polished Painted/coated	0.10 0.80 - 0.95

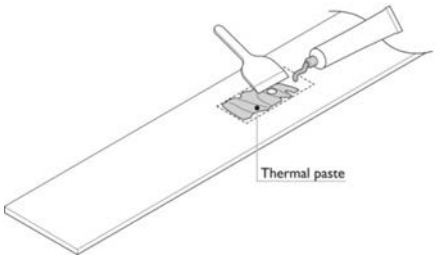


Figure 42. Interface between module and mounting plate filled with thermal paste

Thermal interface

The thermal interface is the interface between the module and the mounting surface in the luminaire. To ensure good thermal contact, it is recommended that the contact area be covered with thermal interface material, e.g. thermal paste (Figure 42).

If the use of thermal paste is not appropriate, and some other thermal interface material is used (e.g. phase change or thermal pad), it is strongly recommended that the installation instructions for the selected interface materials be followed.

Warning!
The use of thermal interface materials other than thermal paste might require a larger heat sink.

Important points for luminaire design

- Ensure good thermal contact between the module/driver and the coldest part of the luminaire
- Ensure a well-defined electrical contact between the module and the luminaire and/or heat sink surface. A coated surface may cause intermittent electrical contact, potentially impairing driver performance.
- Place the module(s) and driver at a distance from each other to obtain a more homogeneous temperature distribution in the luminaire
- When mounting FastFlex LED modules directly on the luminaire housing, we recommend using aluminum that is at least 3 mm thick; thinner material will limit the heat flow through the luminaire housing and thicker material will improve the heat flow through the luminaire housing, resulting in a lower T_{case} of the module
- Use anodized, painted surfaces rather than blank surfaces in order to increase the transfer of heat via thermal radiation

- Use highly thermally conductive materials (e.g. aluminum) in the primary heat path
- Limit the number of thermal interfaces in the primary heat path towards the ambient air

Xitanium LED driver temperature

The next key component is the driver, which influences the lifetime and reliability of the system. It is important to ensure good thermal and electrical contact between the driver and the luminaire as this enables the heat to dissipate efficiently and allows the driver to deliver optimal electrical performance. The driver temperature can be measured with a thermocouple at the Tcase point, shown on the driver label.

Critical driver temperature point with respect to CLO

When the FastFlex LED module is used with Xitanium Programmable LED drivers, CLO will increase the output current. As a result, the driver losses will increase accordingly, which in turn will lead to a higher driver T_{case} temperature. For the thermal design it is therefore important to ensure that the T_{case} temperature of the driver is within specification for its T_{case} max at end of life.

Please refer to individual product datasheets for T_{case} max information.

NTC and thermal design

This feature helps to protect the LEDs when they are operated in a hot ambient environment. The thermal design of an LED module/PCB should be such that the critical temperature (Tc) is not reached under normal application conditions.
The purpose of the NTC is to assure the lifetime of the LED module/PCB in the event that external thermal influences result in the critical temperature being exceeded.

Warning!
Not all drivers have the NTC feature, please check on the website at www.philips.com/xitanium

FastFlex LED module assembly

FastFlex LED module assembly

The FastFlex LED board, the FastFlex lens and the FastFlex module clips are shipped separately. The following section provides module assembly instructions.

Each complete FastFlex LED module consists of three (3) components, Figures 44 to 45, and Table 18. Every module assembly requires 3 module clips.

Figure 43. FastFlex module clips

Figure 44. FastFlex lens

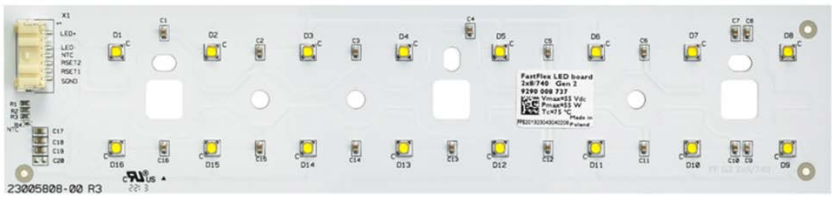


Figure 45. FastFlex Gen2 LED board

Table 20. FastFlex Gen2 LED components for a single module assembly

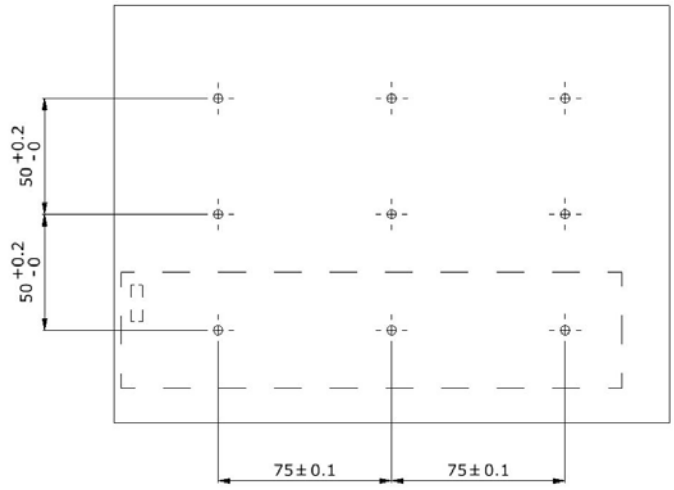
Product	Quantity
FastFlex LED board Gen2	1
FastFlex lens Gen2	1
FastFlex module clip	3

FastFlex lens Gen2 covers the LED board and produces a specific light distribution, depending on the type. The lens plate ID, e.g. IV-X, is marked next to the connector cover.

The assembly of the complete module is divided into two phases:
Pre-assembly and final assembly.
During the pre-assembly phase the lens plate gets a first fixation on the LED board; during the final assembly the module with lens is fixed inside the luminaire.

Mounting hole pattern

The pattern of the holes (in the luminaire) must be checked and inspected before assembly commences.
The drawing supplied describes the hole pattern for each module and also the distance between individual modules.



Mounting hole pattern for FastFlex moduls

It is important to guide the cable between the different modules so it is out of the light path in order to prevent light losses. Do not allow cables to become tangled, keep them short and guided.

N.B.

- It is advisable to wear gloves during the installation of the lenses in order to prevent any dirt affecting the lenses.
- A dust-free environment is recommended.

Lens pre-assembly

FastFlex Gen2 LED modules can be pre-assembled for fast factory manufacturing. The LED board may be covered with the lens in preparation for final assembly

Three (3) mounting holes (Figure 46, in red) are used for pre-assembly of the lens plate on the LED board.

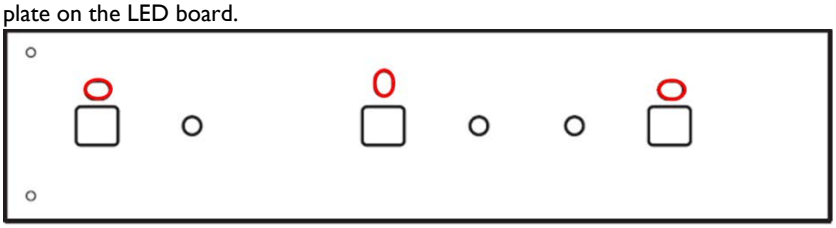


Figure 46. Slots for the lens grippers on the back of FastFlex Gen2 LED board

Each FastFlex lens has lens grippers, a patented feature that (1) ensures the correct alignment of the lens plate with the FastFlex LED board and (2) enables the pre-assembly of the module.

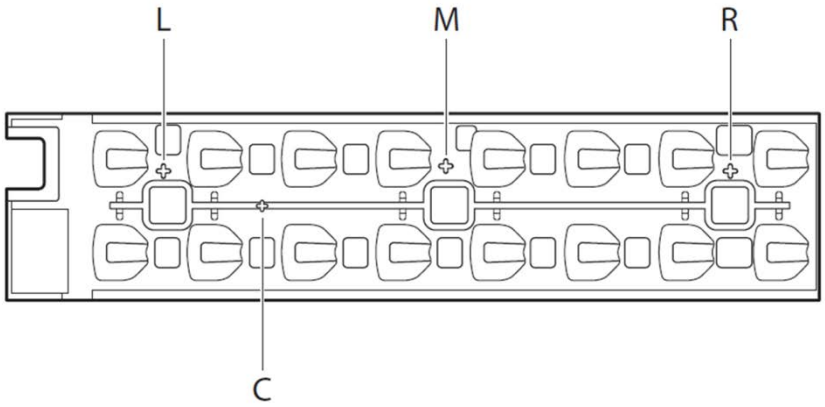


Figure 47. Lens grippers on the FastFlex lens

The lens grippers ensure alignment of the lens plate with the LED Board and enable pre-assembly. There are three (3) grippers on the base of the lens plate: one middle pin (M) and two outer pins (L, R), Figure 47. The pins align the lens plate in 2 different directions. Note that the central pin (C) serves does not support pre-assembly.

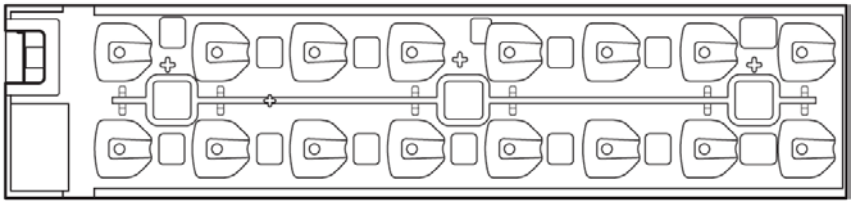


Figure 48. Pre-assembled FastFlex LED module

Manual pre-assembly

To manually pre-assemble the FastFlex LED board and the FastFlex lens:

1. Mount the lens plate on the board. Use the connector position to properly orient the lens. Each LED on the board should fall under each lens on the lens plate.
2. Align the lens plate with the Fast Flex board by inserting the three (3) pins on the bottom side of the lens in the three slotted holes of the PCB.

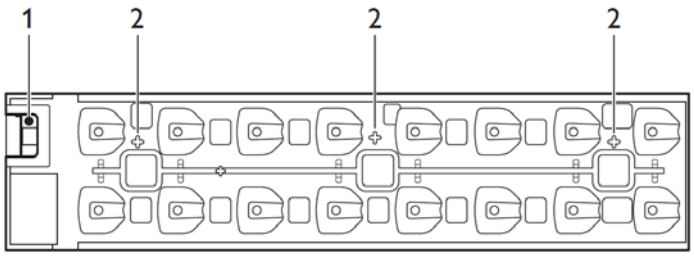


Figure 49. Steps 1 & 2 of manual pre-assembly procedure

3. To insert the pins into the slotted holes, apply pressure evenly with your fingers on the left and right side along the length of the lens plate for each pin, Figure 33. Start with the grippers on the edges (3) and finish with the central gripper (4). Press until the pins are squeezed into the aluminum holes. The squeeze function will hold the lens plate and the PCB together until final assembly.

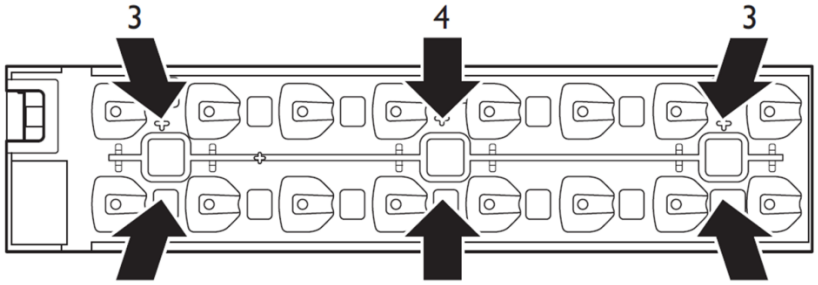


Figure 50. Step 3 of manual pre-assembly procedure

The module has been assembled correctly when there is no visible gap between the lens and the LED board along the entire circumference.
If pressing with the fingers requires too much force, a hand-held tool can be used. The pressing device must have a similar stamp to that shown in Fig. 51.

Pre-assembly with a tool

It is possible to develop a customized tool to mechanically pre-assemble the FastFlex LED module. The tool has two main functions:

1. To force the three pins of the lens plate into the slots of the FastFlex LED board simultaneously,
2. To evenly distribute the push force delivered by a force tool along the width and the length of the LED board.

The lens plate must be aligned on the LED board following steps 1 and 2 of the manual pre-assembly process as described above.

Figure 51 provides an example of a tool developed for mechanical pre-assembly. The tool consists of an orthogonal plate (A) screwed on three (3) π-shaped legs (B). The middle and the outer legs are oriented along the width of the board above the middle and the outer pins of the lens plate respectively. The open area on each leg is needed to avoid pushing the plastic protrusions from the lens's central square slots. The metal structure is connected to a force meter (C).

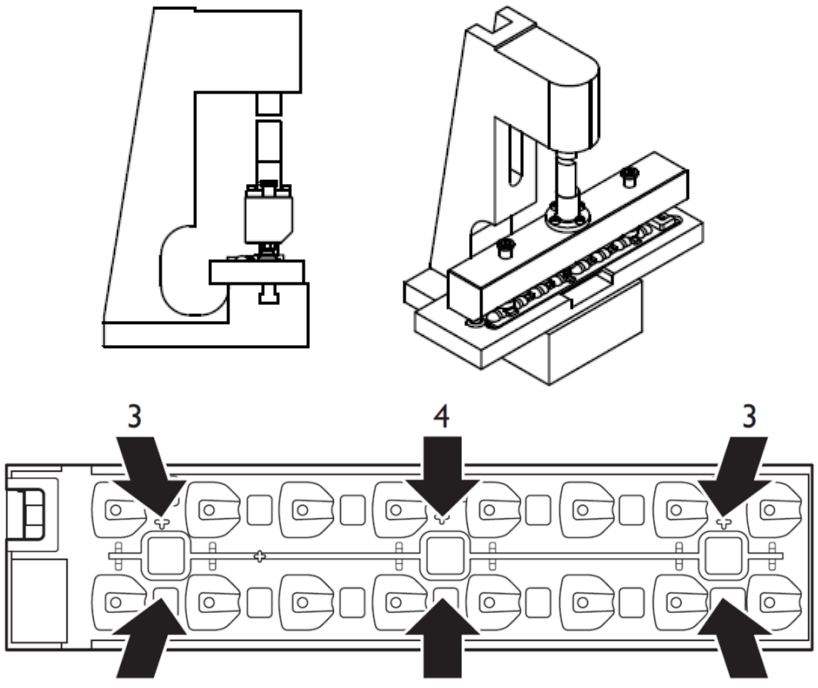


Figure 51. Step 3 of manual pre-assembly procedure

The suggested force is 150 N for each lens gripper.

Figure 52. FastFlex module clips

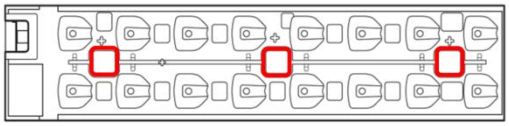


Figure 53. Slots for module clips indicated on pre-assembled FastFlex LED module

The gripper must be constructed of a material that will not damage the lenses.

Final assembly

The FastFlex clip is used for the final assembly in the luminaire. The metal wings introduce a defined force that will hold the LED board pressed onto the luminaire for heat transfer.

To complete the installation of the pre-assembled LED board module on the mounting surface:

1. Tilt the module clip and place it in the mounting slot, Figure 55. Position the metal wings as illustrated, and click one side of the three (3) metal wings in the three (3) central square slots. Once the wings have been clicked into the slots they can move freely towards the left and right x board direction (see arrows in fig 55).

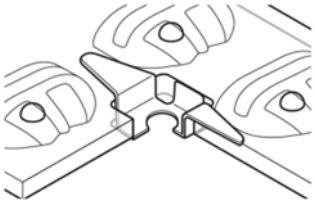


Figure 54. FastFlex module clip mounted in a lens plate

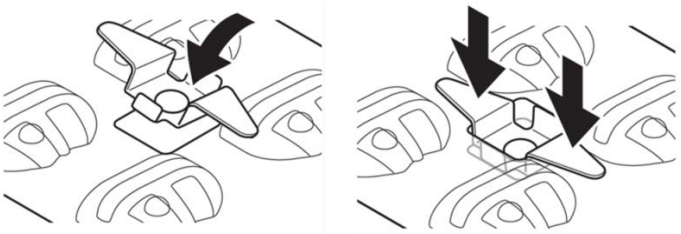


Figure 55. Step 1 of final assembly

2. Insert a screw into each wing hole to fix the pre-assembled module onto the mounting surface. Screw the module onto the fixture until the bottom side of the lens plate touches the LED board.

To fix the module in place we recommend using an M4 hexagonal socket-head cap screw with an M4 spring-lock washer for screws with cylindrical heads. Maximum permitted screw-head diameter is 8 mm.

Installation instructions

Warning!
The FastFlex LED module/s should always be replaced by an OEM-qualified installer.
Special attention should be paid to the following points:

- Do not service the system when the mains voltage is connected; this includes connecting or disconnecting the cable
- Before a new FastFlex LED module is mounted, the old thermal interface must be removed and the area must be cleaned

Mechanical fixation

The separate components (driver and module/s) of the FastFlex LED system can be fixed in place securely using the mounting holes located on the module(s) and driver. Please refer to the dimensional drawings for specific details. The 3D CAD files can be downloaded from the Philips Technology website at www.philips.com/oem.

To fix the system in place we recommend using an M4 hexagonal socket-head cap screw with an M4 spring-lock washer for screws with cylindrical heads. Maximum permitted screw-head diameter is 8 mm.

In a system with multiple modules, it is recommended that the modules are mounted with a distance of between 0 mm and 10 mm maximum between each module to ensure correct optical performance.

Fixation of the module

Before fixing the FastFlex LED module, ensure that the mounting surface is clean and flat, without any protrusions or pits. Also ensure that the electrical connection between the module and the mounting surface is well-defined and not subject to potential intermittent contact due to surface coatings. To ensure a reliable thermal and mechanical attachment, we recommend that the flatness of the mounting surface should be ≤0.2 mm.

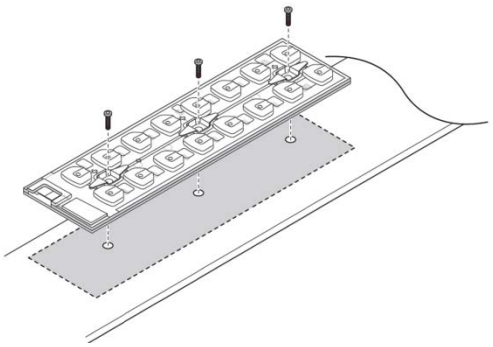


Figure 56. Fixation of the FastFlex LED module

For optimum thermal performance, use a thin layer of thermal paste between the module and the mounting surface. The entire bottom surface of the module needs to be covered with thermal paste, with a typical bond line of 30 to 50 microns. Other thermal interface materials can be used but will require more cooling from the luminaire (i.e. more contact surface between the luminaire and the ambient air). For more information see the *Thermal management* section in this guide.

Fixation of the complete module inside the luminaire

When designing FastFlex LED module into a luminaire, the following should be taken into consideration.

FastFlex lens beam orientation

Some of the FastFlex lenses provide asymmetrical beams.
These lenses can be identified by name, as **-X** will follow the lens number in the name, e.g. FastFlex lens 2x8/II-**X**.
For these lenses, the module position inside the luminaire will directly impact on beam direction.
For all **-X** lenses, the width of the beam falls across the lens, see Figure 57.

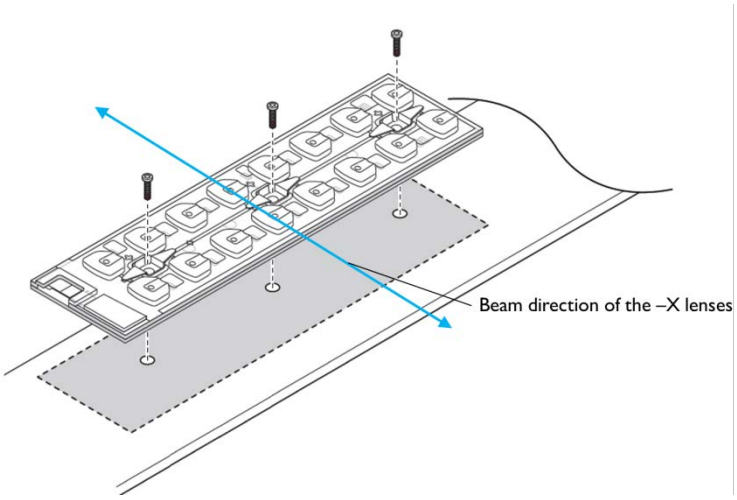


Figure 57. FastFlex lens beam orientation

Luminaire glass

The module should be placed as close as possible to the luminaire front glass in order to reduce optical losses and therefore achieve the best possible LOR.
To optimize thermal performance and minimize reflective glare, we also recommend that the luminaire glass is positioned 2 mm above the highest point of the module (the connector), Figure 58.

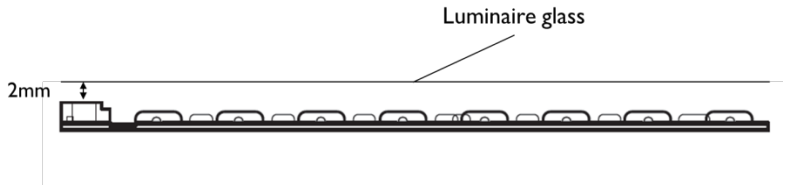


Figure 58. Distance between FastFlex LED module and glass in a luminaire

Fixation of the driver

The Xitanium driver has fixation holes at the short ends of the casing. The driver should be mounted securely on a flat part of the luminaire, using the mounting hole on each side of the driver. Please refer to the specific Xitanium LED driver product datasheet and design-in guide for individual product dimensions and installation instructions.

Connection between module and driver

The FastFlex LED module is compatible with both Rset1 and Rset2 Xitanium LED drivers.

Using the Rset on the module will provide the output current of 530 mA and result in the performance and power consumption specified for that current.
Depending on the type of Xitanium drivers (e.g. AOCM, Programmable …) Rset may or may not need to be connected.

Please search the dedicated driver design-in guide for further details on our website at www.philips.com/xitanium.

Please note that FastFlex LED modules are recommended in combination with specific Xitanium LED drivers. Please refer to Tables 2 to 7 for approved combinations.

Table 21. FastFlex LED board connector pins

Connector	Signal	Description
Pin 1	IDC	LED driver current input (+)
Pin 2	(HV spacer)	Not connected
Pin 3	PGND	Power ground (-)
Pin 4	NTC	Temperature sensor (RNTC) 15 K+390-ohm resistor in series
Pin 5	Rset2	Resistor for current setting of LED driver 2
Pin 6	Rset1	Resistor for current setting of LED driver 1
Pin 7	SGND	Signal ground

Figure 59. Cable Fortimo 7PA to 6wire - 600 mm

Warning!
FastFlex LED module may be operated at any output current between 100 mA and 1000 mA. Operating the module outside the approved output current range will void the warranty and may damage the LEDs.
Philips does not guarantee the performance of the module outside the specified output current range.

FastFlex LED module can be connected to the driver using the cable specified in Tables 2 to 7.

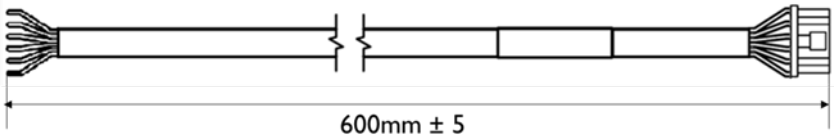


Figure 60. Cable Fortimo 7PA to 6wire - 600 mm

The color coding of the cable wires has been aligned with the color coding of the driver wires to ensure easy installation. Figures 57-59 show the details of the system cable and the wire color coding.

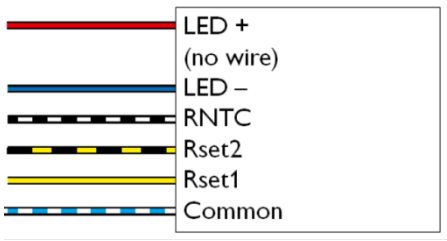


Figure 61. Cable wiring to driver

Table 22. Fortimo 7PA to 6wire cable color coding

Connector pin	Function	Color coding driver/cable
Pin 1	LED+	Red
Pin 2	-	No wire
Pin 3	LED -	Blue
Pin 4	RNTC	Black/White
Pin 5	Rset2	Yellow/Black
Pin 6	Rset1	Yellow
Pin 7	Common	Blue /White

Note:
The Rset2 wire should be left unconnected when Rset1 drivers are used, and vice versa (check the design-in guide for the driver used).

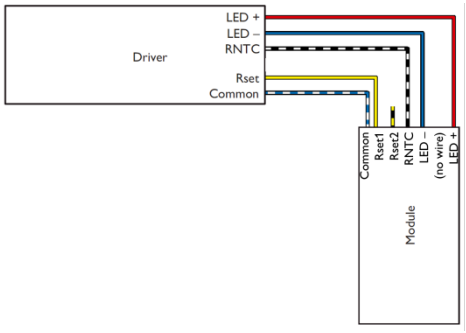


Figure 62. Color coding (one module connected to one Rset1 driver)

Xitanium LED driver with 1 module

In a system with a single module and a single driver, simply connect up the matching colors.

Figure 60 illustrates the connection between a Xitanium Programmable LED driver and a single FastFlex LED module.

The system consists of:

- 1x FastFlex LED module
- 1x Xitanium Prog LED sXt driver (Rset1)
- 1x Cable Fortimo 7PA to 6wire - 600 mm

The unused Rset wires should be clipped short and the wire ends wrapped with an insulating material, e.g. a fiberglass insulating sleeve.

N.B.
It is advisable to place the master module in the center , based on measurement of the worst-case thermal conditions of the modules

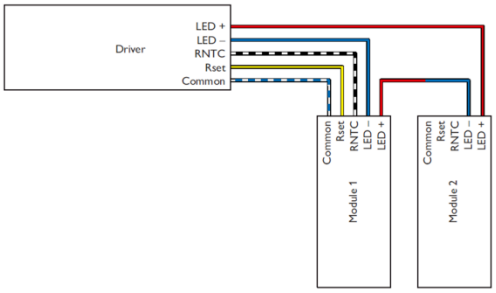


Figure 63. Color coding (two modules connected to one Rset1 driver)

Xitanium LED driver with 2 or more modules

It is possible to connect two or more modules in series to one Xitanium driver by using multiple cables. It is important to note that the driver can only communicate with one of the modules. Because the output current setting and Module Temperature Protection read-out are only available on one of the modules, it is essential to use modules from the same batch. This will ensure the correct performance of the system. The production date code on the module label identifies the batch.

Figure 61 illustrates the connection between a Xitanium Programmable LED driver and two FastFlex LED modules.

The system consists of:

- 2x FastFlex LED modules
- 1x Xitanium LED sXt driver (Rset1)
- 2x Cable Fortimo 7PA to 6wire - 600 mm

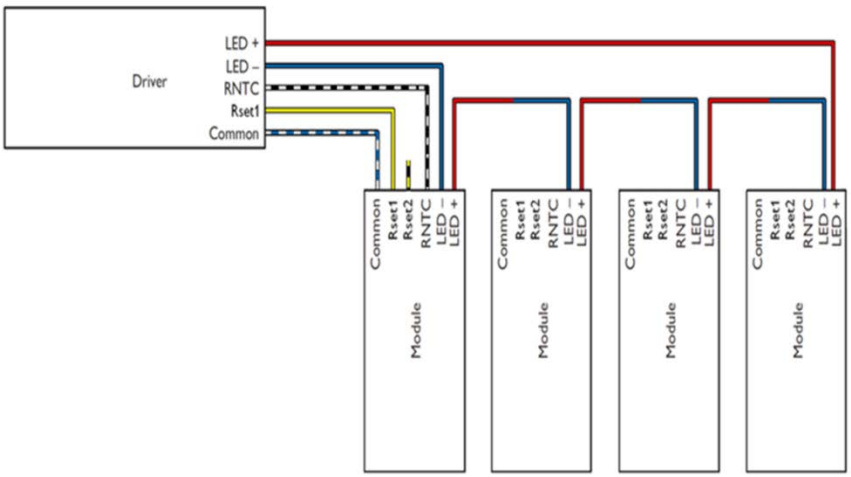


Figure 64. Color coding (four modules connected to one Rset1 driver)

Warning!

- The Rset2 wire should be left unconnected when using Rset1 drivers, and vice versa
- If a system consists of multiple FastFlex modules connected to a single driver, only one module is monitored by the NTC and RSET
- A robust thermal design is strongly recommended
- Always use modules of the same type and batch

Module replacement

When multiple modules are connected to one driver, one module is in "master" mode and the rest are in "slave" mode. Always connect/replace all modules with products from the same series (and preferably the same batch) as LED performance is improving all the time and Philips might decide in the future to decrease the current setting (Rset) to keep the flux level constant. If modules with different Rset values are connected to the same driver, the luminous flux will be determined by the Rset on the master board, possibly resulting in a lower/higher luminous flux for the slave board/s.

Using a long cable in combination with the FastFlex LED module system

It is possible to use a connection between module/s and driver that is longer than the standard 60-cm cable. When using AWG24 cables, the connection can be extended by up to 10 meters without affecting the power supply to the module. It is not advisable to use the communication wires because of possible interference.

- Do not use Rset – output current needs to be programmed in the driver
- Module Temperature Protection (RNTC) function cannot be used
- Do not use the Common wire.
- The unused communication wires should be clipped short and the wire ends wrapped with an insulating material, e.g. a fiberglass insulating sleeve.
- Design-in support is available; please contact your Philips sales representative

Warning!

When using a long cable between the module and driver, extra care should be taken in the design of EMI, surge and noise suppression. It is also important to ensure the cable is guided out of the optical path.

Luminaire isolation Class I and Class II applications

FastFlex LED modules are suitable for luminaire isolation Class I and Class II applications in combination with approved Philips Xitanium LED Xtreme drivers. These approved combinations (Tables 2-7) comply with the latest IEC60598 luminaire standard requirements.

Surge protection in a FastFlex LED system

FastFlex LED modules Gen2 have a high level of integrated protection against the adverse effects of external surges and electro-static discharges. For optimum system protection, apply external common-mode and differential-mode surge protection at luminaire level in order to mitigate the harmful effects of surges on the LED driver and the FastFlex LED module. More details on surge protection can be found in the Application Design-In Guide for the Philips 277V SPD Surge Protection Device.

Quality

Compliance and approval marks

The Philips FastFlex LED board Gen2 is UL and ENEC approved and complies with the applicable EU directives.

To ensure approval of the luminaire, the conditions of acceptance need to be fulfilled. Module-related data can be found in IEC 62031 and UL8750. All luminaire manufacturers are advised to conform to the international standards of luminaire design (IEC 60598 or UL1598).

Sustainability

FastFlex LED modules Gen2 are compliant with European Directive 2011/65/EU, recasting 2002/95/EC on Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS). The modules comply with Reach, as defined by the EU Chemical Agency.

Warranty

The warranty on FastFlex LED module Gen2 performance only applies if the product is used in combination with approved Philips Xitanium LED drivers (Tables 2 to 7).

IP rating, humidity and condensation

FastFlex Gen2 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.

FastFlex LED modules Gen2 are not suitable for direct exposure to moisture, dust, chemicals, salt, etc.

WARNING

FastFlex LED module Gen2 has been developed and released for use in dry and damp locations and not for locations where condensation is present. If there is a possibility that condensation could come into contact with the modules, the system/luminaire builder must take precautions to prevent this.

Photobiological safety

The photobiological safety standard IEC 62471 (*Photobiological safety of lamps and lamp systems*) gives guidance on the evaluation of the photobiological safety of lamps and lamp systems, including luminaires. This standard specifies the exposure limits, reference measurement technique and classification scheme. It should be used 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 to 3000 nm.

Table 23. Wavelengths used for photobiological safety measurements

Radiance-based		
Blue Light	L_B	300 – 700 nm
Retinal Thermal	L_R	380 – 1400 nm
Retinal Thermal	L_{IR}	780 – 1400 nm

Irradiance-based		
Actinic UV Skin & Eye	E_S	200 – 400 nm
Eye UVA	E_{UVA}	200 – 400 nm
Blue Light Small Sources	E_B	300 – 700 nm
Eye IR	E_{IR}	780 – 3000 nm

Measured results of emission limits for FastFlex LED modules Gen2 using the non-GLS (20cm) method are listed in Table 22.

Table 24. FastFlex Gen2 photobiological measurement results

Item	Symbol	Result: Risk group
Actinic UV	Es	Exempt
Near-UV	EUVA	Exempt
Retinal Blue Light	LB	RG1/RG2 threshold distance at 1.27 m[1]
Retinal thermal	LR	Exempt
Infrared eye	EIR	Exempt

[1] Risk group 1 for mounting height above 1.27 m

Conclusion regarding photobiological safety

For complete luminaires, a maximum of risk group 1 is expected to apply for all mounting heights above 1.27m.
Assembly (including optics) in the luminaire can improve the level of photobiological safety.

EMC

Electromagnetic compatibility, EMC, is the ability of a device or system to operate satisfactorily in its electromagnetic environment without causing unacceptable interference in practical situations. In general, LED modules have no effect on the EMC of a luminaire. The FastFlex Gen2 was tested with a Xitanium driver in a reference luminaire and no EMC issues were observed.

Electrostatic discharge (ESD)

Introduction to ESD

It is generally recognized that Electro Static Discharge (ESD) can damage electronic components, like LED chips, resulting in early failures. Professional users of electronic components are used to implementing extensive and rigorous measures to prevent ESD damage in their finished products. With the introduction of LED components for lighting, a new breed of users, such as OEMs and installers, are now involved in handling and using electronic LED components in the manufacturing process.

ESD in the production environment

Depending on the immunity level of the LED board, there is a minimum set of measures that have to be implemented when handling LED boards. ESD measures are required in a production environment where handling can exceed the ESD immunity level. Furthermore, products that are susceptible to ESD must be packed and delivered in ESD-safe packaging.
The purpose of an effective ESD-control strategy is to reduce line failures, final inspection failures and field failures.

ESD specifications

Philips designed FastFlex LED module Gen2 products to be robust when exposed to ESD.
The maximum permitted contact discharge level and air discharge level, according to IEC 61000-4-2 (HBM 150pF + 330Ω), is 8 kV contact and 15 kV air

Servicing and installing luminaires

It is highly recommended that installers are instructed not to touch the LED components and to use earthed arm straps to prevent ESD damage during installation and maintenance.

ESD consultancy

Independent ESD consultancy companies can advise and supply adequate tools and protection guidance.
Philips Innovation Services can provide consultancy at www.innovationservices.philips.com

More information can be found in the *Contact details* section.

Remote system operation

Please consult the design-in guide for Xitanium LED drivers.

Use of circuit breakers: Xitanium LED drivers

Please consult the design-in guide for Xitanium LED drivers at www.philips.com/xitanium

Note on conditions for storage, transportation and operation

- Store in a dark place
- Do not expose to sunlight
- Maintain temperature between -40 and +85 °C
- Relative humidity (RH) between 5% and 85%

During operation

FastFlex Gen2 modules must be operated within the specifications stated in the product leaflet and design-in guide. Please contact your local sales representative for additional information.

System disposal

We recommend that the FastFlex LED module Gen2 and its components are disposed of in an appropriate way at the end of their (economic) lifetime. The modules are in effect normal pieces of electronic equipment containing components that are currently not considered to be harmful to the environment. We therefore recommend that these parts are disposed of as normal electronic waste, in accordance with local regulations.

Appendix A - FastFlex lens material specifications

FastFlex lens product information
Artificial weathering - Material: PLEXIGLAS® 8N clear

Xenon test in accordance with DIN EN ISO 4892-2, method A, cycle 1
Measurement of optical properties in accordance with ISO 13468, D65/10, transmission, 3 mm test piece dimensions.

Table 25. FastFlex lens performance

Analysis	Unit	0 hrs	1,000 hrs	5,000 hrs	7,500 hrs	10000 hrs
Light transmission	%	92.31	92.22	92.15	9,197	9,185
Color coordinate L*	%	96.95	96.91	96.88	9,681	9,676
Color coordinate a*	%	0	-0.02	-0.03	-5	0
Color coordinate b*	%	0.2	0.18	0.18	30	31
Color coordinate x	%	0.3141	0.3141	0.3141	3,143	3,143
Color coordinate y	%	0.3313	0.3313	0.3313	3,316	3,315
Yellowness index	%	0.4	0.35	0.36	58	62
Visual examination	Comments	Colorless / clear	Unchanged	Marginally brighter, marginally noticeable yellowness, marginally noticeable haze.	Marginally brighter, marginally noticeable yellowness, marginally noticeable haze.	Marginally noticeable darkening, marginally noticeable yellowness, marginally noticeable haze.

Material: PLEXIGLAS® 8N clear

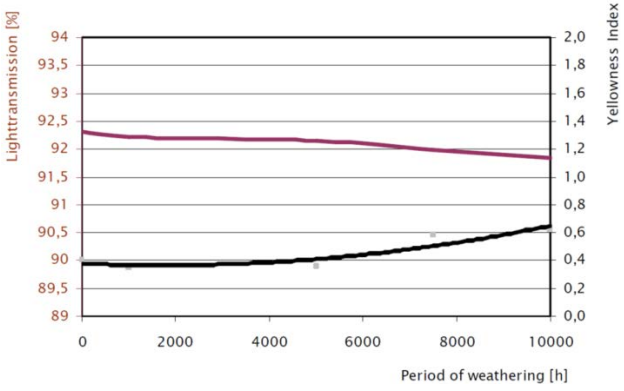


Figure 65. Xeno-weathering results

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Contact details

Philips FastFlex LED module Gen2

The following are suggested products for use with the FastFlex LED module Gen2 systems.

Reference to these products does not constitute endorsement thereof by Philips. Philips makes no warranties regarding these products and assumes no legal liability or responsibility for loss or damage resulting from the use of the information provided here.

Philips ESD support

The Philips corporate EMC competence center is a leading provider of approbation and consultancy services.

Thermal management partners

Asia Vital Components Co., Ltd
The Bergquist Company
Laird Technologies

09/2013
Data subject to change.

www.philips.com/technology