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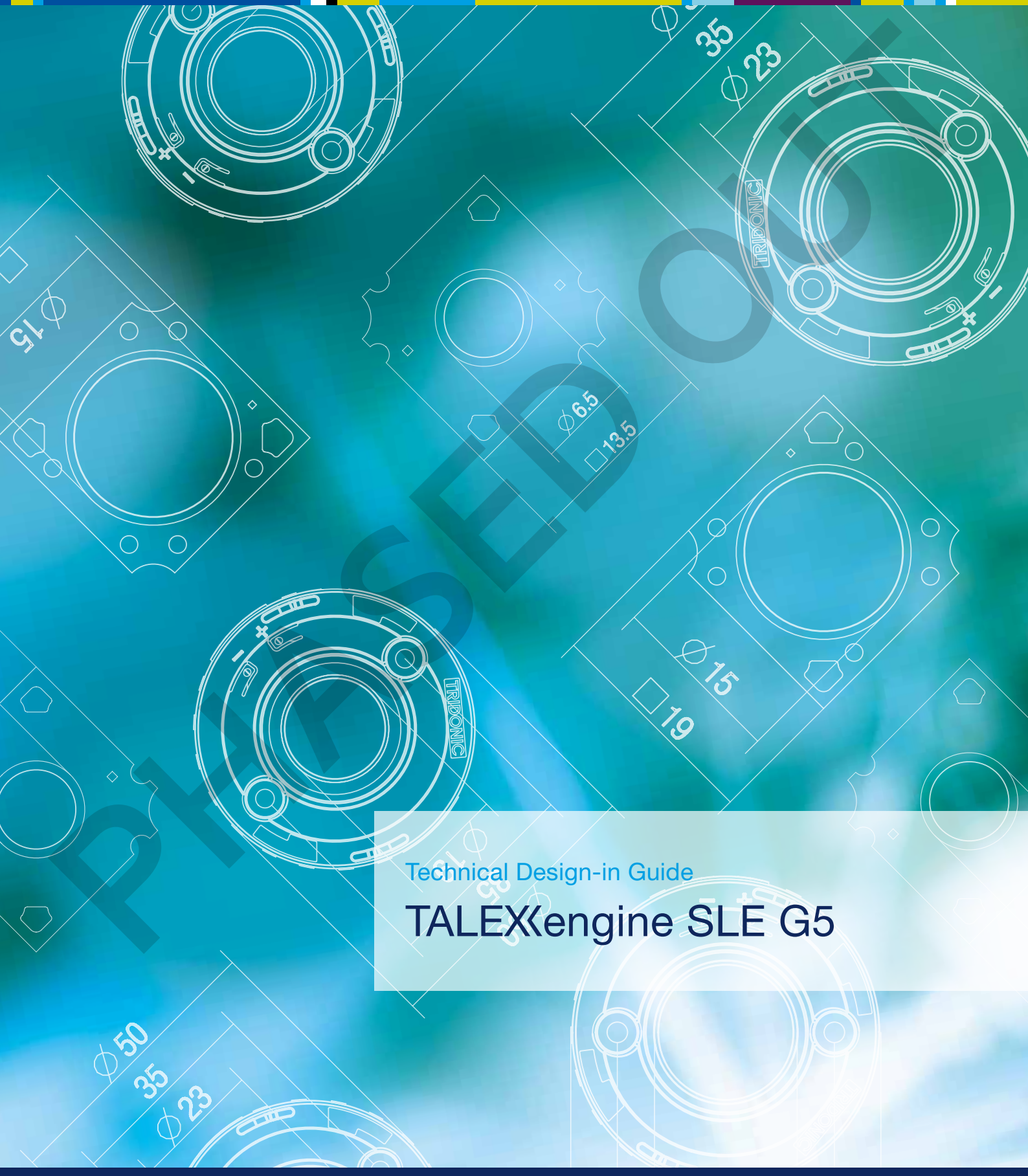

Technical Design-in Guide

TALEXengine SLE G5

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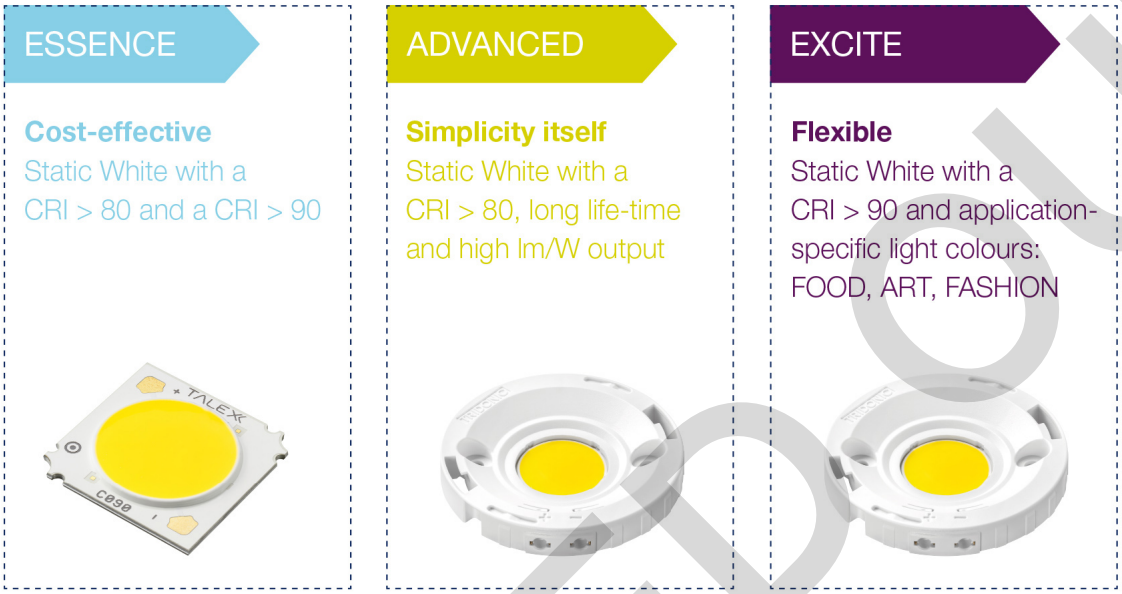
1. Introduction

This design-in-Guide covers the SLE G5 Spotlight system from Tridonic.
The SLE G5 provides energy efficient lighting solutions with high quality light for retail, catering and other spotlight and downlight applications.



The system consists of chip-on-board module and mount, chip-on-board module with pre-tinned wires or chip-on-board module without cable in four versions:

- Standard version with different lumen packages and different light colours (3,000 K, 4,000 K)
- 3 special versions that are optimized for specific applications:
  - » TALEXXengine SLE FOOD:
    LED modules specifically for FOOD applications display foods in the very best light – white elements remain white, colours are more true-to-life and are perceived more intensively. Stronger brown tones for example make baked goods appear more crispy, and the red of meats is emphasised to greater effect.
  - » TALEXXengine SLE ART:
    This new LED module offers the high quality of light that is needed for displaying high value exhibits. Unique Tridonic full spectrum technology provides excellent colour rendering. The average value for all the products in the SLE ART series is CRI 98, a truly impressive figure. And you can also rely on outstanding colour consistency (MacAdam 2) for your applications.
  - » TALEXXengine SLE FASHION:
    The modern FASHION LED light is ideal for the sparkling display of fashion. The technology conceals several years of intensive research targeted specifically for lighting in the retail sector. SLE FASHION generates brilliant colours with pleasant warm tones and high saturation, and completely without UV light, as well as intensive and friendly white tones thanks to the specific blue light component, for the display of goods in perfect, colour-true light.

The Design-in guide provides all the information needed to build a luminaire with the SLE G5 Spotlight system and adapt it to the desired needs.

This includes:

- Dimensioning of the heat sink and reflector
- Selection of compatible LED drivers
- Designing the luminaire with respect to thermal and mechanical needs

2. System overview

2.1. Complete system solution

The use of LEDs in general lighting has many advantages: LEDs are versatile in their application, highly energy efficient and virtually maintenance-free. With the TALEXXengine SLE GEN5 you get a complete system solution for spot and downlights, consisting of perfectly matched components: LED module and LED driver.

NOTICE

All information in this guide has been created with great care. Errors, additions and omissions excepted. For any resulting damage Tridonic accepts no liability. The latest version of this guide can be found at led.tridonic.com or at your sales partner.

2.2. Zhaga

Zhaga is a consortium, initiated in 2010, which takes care of the needs of LED lighting and its standardisation. It is active worldwide and has more than 200 member companies (as of 2012).

The aim of the Zhaga consortium is to ensure interchangeability and compatibility of LED luminaires between different manufacturers. To this end, Zhaga defines standards for the interfaces of the various lighting fixtures and holders. This includes the physical dimensions of the lamp base, as well as the photometric, electrical and thermal behaviour of LED luminaires. These standardizing measures help to make products comparable, a step that both the manufacturing industry and the consumers benefit from.

The Zhaga logo verifies compatibility with Zhaga standards. Only certified devices are allowed to bear this logo.

The SLE GEN5 modules meet the mechanical requirements of the Zhaga guidelines from book number 3. Products that meet the Zhaga standards in physical, electrical and thermal points are listed on the website of Zhaga: www.zhagastandard.org

2.3. Module variants

NOTICE

The TALEXXmodule SLE GEN5 series comprises different variants of modules:

- with housing
- with housing and thermal interface material
- without housing, with or without connection cable

Modules without housing or connection cable have a certain affix in their name:

- Modules without housing have the affix "H" in their name
- Modules with housing and thermal interface material have the affix "H" and "T" in their name
- Modules with connection cable have the affix "C" in their name
- Modules without connection cable have the affix "R" in their name

Modules without housing or connection cable have a certain affix in their name:

- Modules without housing have the affix "PURE" in their name
- Modules without connection cable have the affix "W/O-C" in their name

Abbreviations:

- XD ... Xtreme Density; H ... housing; T ... thermal interface material; C ... cable; R ... raw

The following variants are available:

Module name	Housing	Thermal interface material	Connection cable
with affix "XD", e.g. SLE G5 6mm 1200lm 830 XD R ADV	✗	✗	✗
with affix "H", e.g. SLE G5 19mm 5000lm 830 H ADV	✓	✗	✗
with affix "H" and "T", e.g. SLE G5 19mm 5000lm 830 H ADV T	✓	✓	✗
with affix "C", e.g. SLE G5 19mm 5000lm 830 C ADV	✗	✗	✓
with affix "R", e.g. SLE G5 19mm 5000lm 830 R ADV	✗	✗	✗

The system TALEXXengine STARK SLE GEN4 is available in different variants:

	SLE GEN5 Advanced	SLE GEN5 Excite
Main qualities	Simplicity itself: » Static White with a CRI > 80 » long life-time » high lm/W output	Flexible: » Static White with a CRI > 90 » Application-specific light colours: FOOD, ART, FASHION
Available variants	Available in 4 variants: » with housing, without thermal interface material » with housing, with thermal interface material » without housing, without thermal interface material » without housing, with thermal interface material	Available in 4 variants: » with housing, without thermal interface material » with housing, with thermal interface material » without housing, without thermal interface material » without housing, with thermal interface material
Light Emitting Surface (LES)	6mm, 11mm, 15mm, 19mm, 23mm	6mm, 11mm, 15mm, 19mm, 23mm
Colour temperature	3,000 K, 4,000 K	3,000 K, 4,000 K plus application-oriented light colours for FOOD, ART and FASHION applications
Luminous flux (1)	up to 8,440 lm	up to 7,430 lm
Colour rendering / colour tolerance	up to CRI 80 MacAdam 3 SDCM	up to CRI 90 MacAdam 3 SDCM
System efficiency (1)	up to 150 lm/W	up to 134 lm/W
Module efficiency	up to 173 lm/W	up to 156 lm/W
Energy efficiency class	up to A++	up to A+
Life time (2)	60,000 h	60,000 h
Warranty	5 years	5 years

(1) Values at t_p=65°C, all values apply to tp rated
(2) relating to L70/B50

2.3.1. Type code for modules

The following type code is used to identify the modules:

Type code for modules for SLE G5 19mm 5000lm 830 H ADV T for example

Reference	SLE G5	19mm	5000lm	830	H	ADV	T
Meaning	Form: Spotlight Engine	Size	Type: Luminous flux at nominal current	CRI 80 3000K	with housing	Advanced	with thermal interface material (TIM)

2.4. Accessories

2.4.1. LED drivers

LED drivers are available in different variants:

		Dimming		Fixed Output	
		ECO Leader in efficiency and versatility	**BASIC** Economic dimming convenience	**TOP** Optimum performance and high flexibility	**TEC** Reliable and straightforward
Dimming	Dimming method	Amplitude & PWM	Amplitude only		
	PWM frequency	500 Hz			
	Dimming range	1 – 100 %	10 – 100 %		
	DALI DT6 / DSI	yes			
	switchDIM / corridorFUNCTION	yes			
	Phase-cut dimming		yes		
DC operation	Supporting EN 50172	yes		yes	
	DC level fixed			yes	

	DC level adjustable	yes			
Output current	Adjustable	yes		yes	
	Via resistor or plug (I-Select)	yes		yes	
	Via DALI	yes			
	Current resolution	1/25/50 mA 1)		25/50 mA 1)	
	Current tolerances	+/- 3 %	+/- 7.5 %	+/- 5 %	+/- 7.5 %
Functions & Performance	Constant light output over lifetime	yes			
	Intelligent Temperature Guard	yes	yes	yes	yes
	Intelligent Temperature Management	yes		yes 2)	
	Standby losses	< 0.2 W			
	Input voltage range	220 – 240 V	220 – 240 V	220 – 240 V	220 – 240 V
	Lifetime up to	100,000 h	50,000 h	100,000 h	50,000 h
	Failure rate	0.1 % / 1,000 h	0.2 % / 1,000 h	0.1 % / 1,000 h	0.2 % / 1,000 h
	Operating temperature range	-25 °C up to +65 °C 3)	-25 °C up to +50 °C	-25 °C up to +65 °C 3)	-20 °C up to +50 °C
	Warranty	5 years	5 years	5 years	5 years

1) Depending on the output current range and setting method (I-Select or DALI)
2) For drivers with 35 W and more
3) Varies with the selected output power, detailed values can be found in datasheet

2.4.2. Possible combinations

Possible combinations of LED drivers and LED modules can be found in the LED system matrix:
www.tridonic.com/com/en/lamp-matrix.asp

Some typical combinations are listed here:

- SLE G5 6mm 1200lm XD: Operating current: 180mA
  - » Dimmable: LCBI 10W 180mA phase-cut/1-10 V SR (Article number: 87500273)
- SLE G5 11mm 3000lm XD: Operating current: 500mA
  - » Dimmable: LCAI 20W 350mA-900mA ECO C (Article number: 28000122)
  - » Fixed output: LCI 35W 350mA-900mA TOP C (Article number: 28000193)
- SLE G5 15mm 5000lm XD: Operating current: 1050mA
  - » Dimmable: LCAI 55W 900mA-1750mA ECO C (Article number: 28000128)
  - » Fixed output: LC 45W 1050mA fixC C SNC (Article number: 87500397)
- SLE G5 15mm 2000lm: Operating current: 350mA
  - » Dimmable: LCAI 15W 150mA-400mA ECO Slim (Article number: 28000445)
  - » Dimmable: LCAI 20W 350mA-900mA TOP C (Article number: 28000122)
  - » Fixed output: LCI 20W 350mA-900mA TOP C (Article number: 28000191)
  - » Fixed output: LC 15W 350mA fixC C SNC (Article number: 87500393)
- SLE G5 15mm 3000lm: Operating current: 500mA
  - » Dimmable: LCAI 20W 350mA-900mA ECO C (Article number: 28000122)
  - » Fixed output: LCI 20W 350mA-900mA TOP C (Article number: 28000191)
  - » Fixed output: LCI 20W 500mA TEC C (Article number: 87500188)
- SLE G5 15mm 4000lm: Operating current: 900mA
  - » Dimmable: LCAI 55W 900mA-1750mA ECO C (Article number: 28000128)
  - » Fixed output: LCI 55W 900mA-1750mA TOP C (Article number: 28000199)
  - » Fixed output: LC 40W 900mA fixC C SNC (Article number: 87500364)
- SLE G5 19mm 5000lm: Operating current: 1050mA
  - » Dimmable: LCAI 55W 900mA-1750mA ECO C (Article number: 28000128)
  - » Fixed output: LCI 55W 900mA-1750mA TOP C (Article number: 28000199)
  - » Fixed output: LC 45W 1050mA fixC C SNC (Article number: 87500397)
- SLE G5 23mm 6000lm: Operating current: 1400mA
  - » Dimmable: LCAI 55W 900mA-1750mA ECO C (Article number: 28000128)
  - » Fixed output: LCI 55W 900mA-1750mA TOP C (Article number: 28000199)
  - » Fixed output: LC 60W 1400mA fixC C SNC (Article number: 87500417)

Type codes for LED drivers

The following type code is used to identify LED drivers:

Type code for LED drivers for LCAI 35W 350mA-900mA ECO C for example

Reference	LCAI	35W	350mA-900mA	ECO	C
Meaning	LED drivers for constant current	Power	Output current range	Type	Housing form "compact"

The exact type designation of the LED driver can be found on the label of the LED driver.

2.5. Compatibility between LED module and LED driver

⚠ CAUTION!

TALEXXmodule SLE G4 are basic isolated against ground up to 75 V (for LES6, LES11 and LES15: 50 V) and can be mounted directly on earthed metal parts of the luminaire.
If the max. output voltage of the led driver (also against earth) is above 75 V (for LES6, LES11 and LES15: 50 V), an additional isolation between LED module and heat sink is required (for example by isolated thermal pads) or by a suitable luminaire construction.

At voltages > 60 V an additional protection against direct touch (test finger) to the light emitting side of the module has to be guaranteed. This is typically achieved by means of a non removable light distributor over the module.

There are two stages involved in the check for compatibility between the LED module and the LED driver.

- The requirements for operating together can be checked by comparing the data sheets
- Subsequent practical tests can ensure that there are no unexpected problems during actual operation

2.5.1. Comparison of data sheet values with a 5-point guideline

Different values for the two devices need to be considered when comparing the data sheets. The following table shows which values are involved and which requirements they must meet.

Comparison of…	Value in LED module		Value in LED driver	Detailed procedure
(1) Current	I_{max}	=	Output current	» Determine forward current of LED module » Check whether LED driver can be operated with the same output current » Check whether max. DC forward current of LED module is greater than or equal to output current of LED driver (including tolerances) **⚠ CAUTION!** The max. DC forward current can be temperature dependent! Refer to the derating curve of the LED module data sheet.
	Max. DC forward current	≥	Output current + tolerances	

continue... → ↓

Comparison of…	Value in LED module		Value in LED driver	Detailed procedure
(2) Voltage	Min. forward voltage	>	Min. output voltage	» Check whether voltage range of LED module is completely within the voltage range of LED driver
	Max. forward voltage	<	Max. output voltage	**⚠ CAUTION!** The forward voltage is temperature dependent! Refer to the Vf/t_p diagram in the data sheet.
	Min. forward voltage @ min. dim level	>	Min. output voltage	**ⓘ NOTICE** To ensure full dimming performance the forward voltage of the LED module at min. dim level must be greater than or equal to the min. output voltage of the driver. » Determine the forward voltage of the LED module at lowest dim level » In case there is no data available for the LED module at lowest dim level: take the min. forward voltage minus 20% as an approximation » Check whether the forward voltage of the LED module is greater than or equal to the min. output voltage of the driver
(3) LF current ripple	Max. permissible LF current ripple	≥	Output LF current ripple (<120Hz)	» Check whether max. permissible LF current ripple of LED module is greater than or equal to output LF current ripple of LED driver
(4) Max. peak current	Max. permissible peak current	>	Max. peak output current	» Check whether max. permissible peak current of LED module is greater than max. peak output current of LED driver
(5) Power (pertinent for multi channel LED driver)	Min. power consumption	>	Min. output power	» Check whether power range of LED module is completely within output power range of LED driver
	Max. power consumption	<	Max. output power	

2.5.2. Practical tests

⚠ CAUTION!

Following the comparison of the data sheet values a practical test is required. Only a practical test can ensure that the system components (luminaire, LED driver, LED module, wiring) are coordinated and working properly.

The following aspects must be checked:

Technical aspects

- Transient behaviour
- Colour shift
- Connection during operation
- Parasitic capacitance

Visual aspects

- Flickering
- Stroboscopic effect (video applications)
- Dimming behaviour
- Colour change/stability
- Luminous flux

When conducting the tests the following conditions must be considered:

Conditions

- All tolerances
- Entire temperature range
- Different output voltage ranges (incl. no load)
- Entire dimming range
- Short circuit

ⓘ HINWEIS

If the values are slightly over or under the specified threshold values or if there are any other concerns or questions please contact Technical Support:
techservice@tridonic.com

2.6. Standards and directives

2.6.1. Standards and directives for modules

The following standards and directives were taken into consideration in designing and manufacturing the modules:

CE

2006/95/EG	Low-voltage directive: Directive relating to electrical equipment for use within certain voltage limits
2004/108/EG	EMC directive: Directive relating to electromagnetic compatibility

RoHS

2002/95/EC	RoHS(1) directive: Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment

(1) RoHS: Restriction of (the use of certain) hazardous substances

Safety

DIN IEC 62031:2008	Safety requirements for LED modules
EN 60598-1:2008 und A11:2009	General requirements and tests for luminaires
EN 60598-2-2:1996 und A1:1997	Luminaires - Part 2. Special requirements; Main section 2: Recessed luminaires
EN 62471:2008	Photo-biological safety of lamps and lamp systems

Safety and performance

EN 61347-1:2009	General and safety requirements
EN 61347-2-13:2007	Special requirements for dc and ac powered electronic operating equipment for LED modules
EN 62384:2007 IEC 62384 A1:2009	Operational requirements

Energy labelling

EU Regulation No: 874/2012	"Energy labelling of electrical lamps and luminaires"

2.6.2. Standards and directives for LED drivers

The following standards and directives were taken into consideration in designing and manufacturing the LED drivers:

EMI

EN 55015 2008	Limit values measurement methods for radio interference properties of electrical lighting equipment and similar electrical devices
EN 61000-3-2:2005 A1: 2008 und A2:2009	Limit values for harmonic currents (equipment input current < 16 A per conductor)
EN 61000-3-3:2005	Limit values for voltage fluctuations and flicker in low-voltage systems for equipment with an input current < 16 A per conductor that are not subject to any special connection conditions
EN 61547:2001	EMC(1) requirements

(1) EMC: Electromagnetic compatibility

Safety

EN 50172 2005	Safety lighting systems

DALI

IEC 62386-101:2009	General requirements, system
IEC 62386-102:2009	General requirements, controller
IEC 62386-207:2009	Special requirements, controller; LED modules

3. Mechanical aspects

3.1. Installation

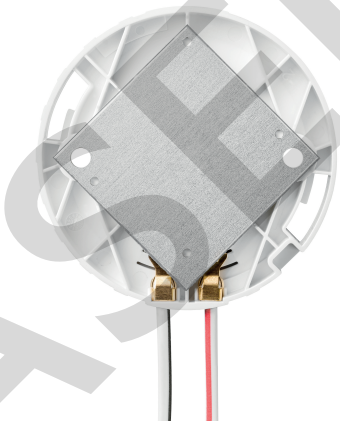
The SLE GEN5 modules were tested with severity level 4. The guideline for installation can be taken from the ESD document .

NOTICE

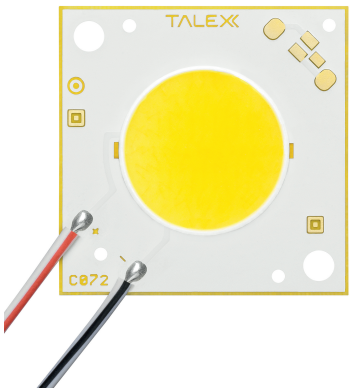
EOS/ESD safety guidelines
The device/module contains components that are sensitive to electrostatic discharge and may only be installed in the factory and on site if appropriate EOS/ESD protection measures have been taken. No special measures need be taken for devices/modules with enclosed casings (contact with the pc board not possible), just normal installation practice.
Please note the requirements set out in the document EOS/ESD guidelines (Guideline_EOS_ESD.pdf) at:

- http://www.tridonic.com/com/de/download/technical/Richtlinie_EOS_ESD_de.pdf
- http://www.tridonic.com/com/en/technical-docs.asp

Integrated terminal for a time-saving assembly



Back of the module for thermal connection to the heat sink



Version without housing for individual integration in the light

⚠ CAUTION!

The TALEXXmodule and its housing are pressed together by pressure. This ensures a reliable contact between the spring clip and the module contacts! TALEXXmodule and housing must not be separated!

- If TALEXXmodule and housing are separated and then reconnected the correct connection of the contacts between TALEXXmodule and its housing is no longer guaranteed. This can cause malfunctions, flashovers or damage to the TALEXXmodule.
- The separation and reconnection of parts causes mechanical stress which can damage or deform the parts.

In addition, the following must be observed:

- All warranty and guarantee claims are void if TALEXXmodule and housing are separated or if the TALEXXmodule is altered, modified or disassembled in any form.

3.1.1. Notes on installation

Depending on the installation situation for the LED driver and the modules, the following requirements must be met:

- Sufficient distance to active conducting materials
- Sufficient strain relief when the LED driver cover is closed
- Sufficient cooling of the modules (the max. temperature at the tc point must not be exceeded)
- Unrestricted exit of light from the modules
- The module's push-in terminals allow easy wiring. They can be released via the trigger

Protection measures against damage

Mechanical stress

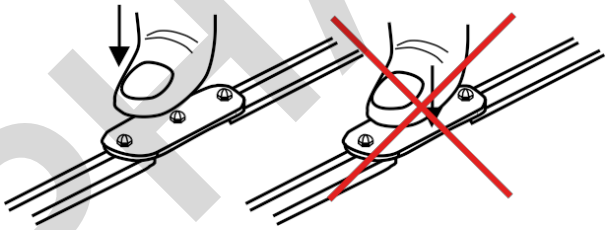
TALEXX modules contain electronic components that are sensitive to mechanical stress. Such stress should be kept to an absolute minimum. In particular the following mechanical stresses should be avoided as these may cause irreversible damage:

- Pressure
- Drilling
- Milling
- Breaking
- Sawing
- and similar mechanical processing.

Compressive stresses

The components of the TALEXX modules (circuit boards, glob-top, lenses, electronic components etc.) are sensitive to compressive stresses. The components must not be exposed to compressive stresses.

- If glass or Plexiglas shields are used make sure that pressure is not exerted on the glob-top.
- Only touch the TALEXX modules at the edges



correct (left) and incorrect (right)

Chemical compatibility

LED modules can be damaged by other materials, if these materials have certain chemical properties. The cause for these damages are different gaseous compounds, which penetrate into the encapsulant of the LED and thereby attack the encapsulant, the colour conversion phosphor or the LED chips and can affect the electrical contacts or the substrate.

Application areas for chemical substances

The following are known areas in which chemical substances are used:

- use of protective coating in applications with high relative humidity (outdoor applications),
- encapsulation of LED modules,
- cementing of LED modules,
- sealing of luminaires.

The following materials must be checked for their safety:

- All components and auxiliaries used in the assembly of the luminaire:
  - » Solvents of adhesives and coatings
  - » Other so-called VOC ("volatile organic compounds")
- All other additional substances present in the atmosphere:
  - » Outgassing of adhesives, sealants and coatings
  - » Cleaning agents and processing aids (e.g. cutting oils and drilling coolants)

NOTICE

Contact your LED manufacturer for questions about the materials used and possible interactions and risks.

Putting together a "safe list" is not possible due to the complexity of the topic. The following table lists possible contaminants for LED modules, the classes of compounds and examples of possible sources.
The list shows the most commonly used materials but does not claim to be complete.

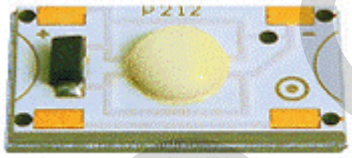
Class of compounds	Chemical names	Occurs in
Acids	» hydrochloric acid » sulfuric acid » nitric acid » phosphoric acid	» cleaner » cutting oils
Organic acids	» acetic acid	» RTV silicones » cutting oils » degreaser » adhesives
Alkalis	» ammonia » amines » sodium hydroxide	» detergents » cleaner
Organic solvents	» ethers (e.g. glycol) » ketones (e.g. Methylethylketon) » aldehydes (e.g. formaldehyde) » aromatic hydrocarbons (e.g. xylene and toluene)	» cleaner » benzine » petroleum » paints and varnishes
VOC (volatile organic compounds)	» acetate » acrylates » aldehydes » serve	» super glue » all-purpose glue » screw locking varnish » coatings » paints and varnishes
Mineral oils	» hydrocarbons	» machine oil » lubricants
Vegetable oils and synthet. oils	» siloxanes » fatty acids	» silicone oils » linseed oil » fats
Harder, vulcanizer	» sulfur compounds	» seals » sealants » colours

Protection measures for the glob top material

The following guidelines must be observed to avoid damage to the glob-top:

- Make sure that the chemicals used in LED applications are not solvent-based, condensation crosslinked or acetate crosslinked (acetic acid). These give rise to reagents (e.g. solvent vapors, acetic acid) that may damage LED modules or the encapsulant. This applies to chemicals that are used not in the immediate vicinity of the modules (e.g. seals) and also to chemicals that come into direct contact with the modules (e.g. insulating coatings, adhesives).
- To ascertain the chemicals used and the type of cross linking a technical data sheet containing a list of substances must be requested from the manufacturer.

Example of damaged encapsulant material, recognizable by the change of the chromaticity coordinates:

	
powerLED P211, original	powerLED P211, damaged by dissolver waste gas

Protection measures in regards to sealing

The points above also apply to chemicals used for sealing luminaire casings. If however the LED module is not installed in the luminaire until after the sealing compound has been completely cured (see relevant material information) the above points can be ignored.

If the LED modules have already been installed in the luminaire, possible damage to the encapsulant can be reduced to a minimum by ensuring adequate spacing (>10 cm) and ventilation (open casing and air circulation, extraction / fan) during the curing process.

Protection measures in regards to cementing

To avoid damaging the LED modules you must not use any tools or exert any pressure on the electronic components or the encapsulant.

- If glass or Plexiglas shields are used make sure that pressure is not exerted on the encapsulant.
- Only touch the LED modules at the edges

Cleaning the LED module

⚠ CAUTION!

It is not permitted to clean LED modules during operation. It is necessary to disconnect the power supply. This means for example removing the spotlight from the supply rail only after that it is allowed to clean the module.

There are two options for cleaning the LED module:

Cleaning with compressed air

Procedure

- Apply compressed air at an angle of appr. 45° and a distance of 5 cm

Cleaning with Isopropyl alcohol

⚠ CAUTION!

Mechanical stress may damage the LED module's bond wires, compound or other fragile parts.

- Don't apply mechanical stress onto the LED module while cleaning

ⓘ NOTICE

The product's warranty expires in case the LED module was damaged as a result of mechanical stress.

Procedure

- Moisten cotton pads with isopropyl alcohol, make sure that it doesn't get wet!
- Clean the LED module with the moist cotton pads
- Use new and dry cotton pads to remove remaining isopropyl alcohol from the LED module

Instructions for cementing TALEXX modules

Preparation

Clean and durable bonding of two materials requires special attention.
The following cleaning agents are recommended:

- Isopropanol / Water 50/50
- Acetone
- Heptane

Important aspects

- Carrier material
  The carrier material must have adequate thermal conductivity (e.g. aluminium). The size of the cooling surface depends on the power of the LEDs, among other things. For information on the cooling surface required, see the appropriate product data sheet.
- Adhesive material
  The carrier material itself plays an important role in selecting the adhesive material. The crucial factors are the coefficient of expansion and compatibility with the base material of the TALEXX module board (plastic or aluminium). This must be checked in the application in terms of long-term stability, surface contamination and mechanical properties.
- Surface quality
  The carrier material must be uncoated (thermal transport, adhesion) and level at the connection points.
- Installation temperature
  To achieve optimum adhesion we recommend you carry out this work at room temperature.
- Duration, optimum adhesive strengths
  Maximum adhesion is achieved within 48 hours at room temperature; the process is accelerated by heat. In actual practice this means that at the maximum t_c temperature (approx. 75-85 °C, product-specific) maximum adhesion is reached after about 12 hours. During the curing period make sure that there is no tensile load on the adhesive connection of the TALEXX module.

Additional information

TALEXX modules must not be stuck and restuck time and again without replacing the adhesive tape. Damaged adhesive tapes must be completely removed and replaced by new tapes.

Packaging and transport

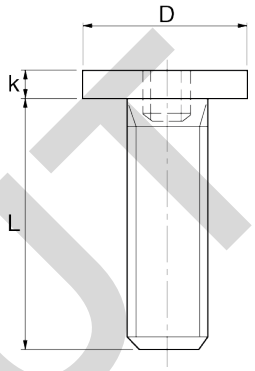
TALEXX products from Tridonic are delivered in appropriate packaging. The packaging provides special protection against mechanical damage and ESD (electrostatic discharge). If you need to transport TALEXX products you should use this packaging.

3.1.2. Installing the modules

The modules are mounted on a heat sink with 2 bolts per module. In order not to damage the modules only raised head bolts should be used. The bolts should be selected on the basis of the following dimensions:

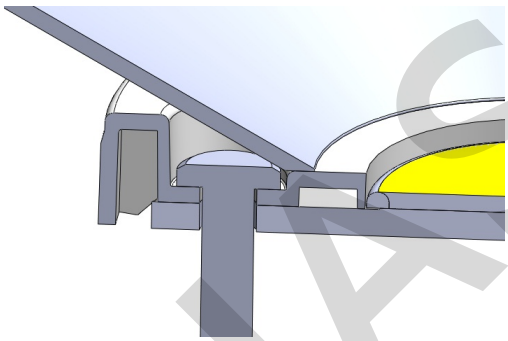
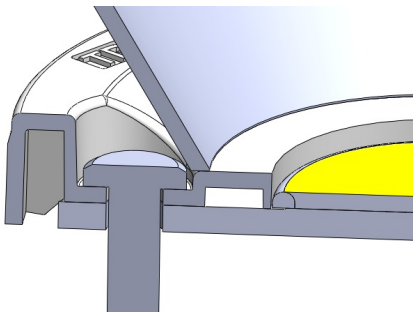
Dimensions of the fastening bolts

Bolt size	M3 (1)
Max. diameter D	5.8 mm
Min. length L	10 mm
Max. length L	Depending on the design of the luminaire and the heat sink
Max. bolt head height k	1.3 mm for flat reflectors, higher values for steep reflectors
Max. torque	0,5 Nm



(1) Use M3 bolts according to DIN 84 (ISO 1207, UNI 6107).

Different bolt head heights

Flat reflectors	Steep reflectors
	
The bolt head height of flat reflectors must not exceed a maximum of 1.3 mm.	The bolt head height of steep reflectors can be more than 1.3 mm.

3.1.3. Procedure for hand soldering

The following describes how a solder joint must be made and checked. Tridonic components are tested according to IPC-A-610 E Class 2. For this reason, the measures described below are defined for hand soldering and the visual inspection of the parts.

Important specifications in accordance with IPC-A-610 E

Magnification aids

Magnification aids that are used for testing, must be suitable for the inspected object.

Insulation

Insulation must be separated cleanly from stranded wires. The insulation must not be charred and the insulation must not be fused into the strands.

It is allowed for the insulation to be slightly melted after soldering. Generally, the distance between the end of the wire insulation and the solder of the solder joint should be one wire diameter, max. two wire diameters. Additionally the minimum electrical isolation distance to adjacent non-connected conductors can't be too low.

Lines – tin coating

Strand wires should be evenly coated with a thin layer of solder, so that individual wires are still visible. Areas of the wire that need to be flexible shall not be tin-coated.

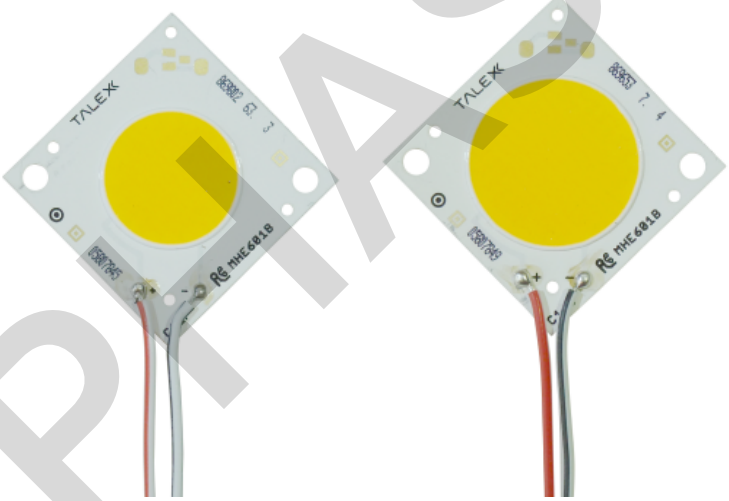
General guidelines and tips

- It is recommended that only trained and experienced personnel perform hand soldering tasks.
- It is recommended to use a soldering iron with at least 75 W.
- The size of the soldering tip should fit the soldering joint. It is recommended to use a tip with a width of 2 mm.
- The soldering material should be a SnAgCu (Pb free) alloy with flux core. It is recommended to use soldering material with a diameter of 0.5 - 0.8 mm. Thinner soldering material dissipates less energy from the solder joint.
- Adding flux is not necessary.
- It is strongly advised against soldering the solder joint more than two times.
- Preheating with a heating plate is not recommended.
- It is recommended to choose a soldering temperature between 250 °C and 300 °C and a soldering time of 5 seconds. The solder pad can be tin-coated.

Alignment of the cables

Figure: Alignment of the cables on solder pad LES6, LES11, LES15 (soldering points on opposite corners of the solder pad)

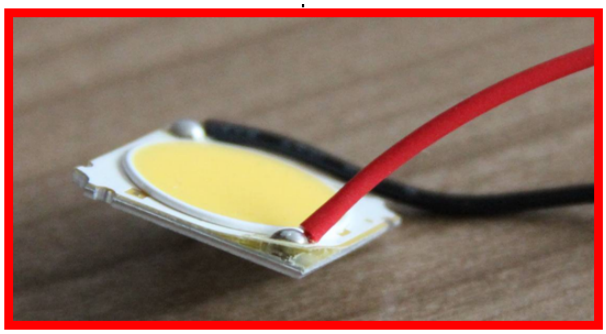
Figure: Alignment of the cables on solder pad LES19, LES23 (soldering points in one corner of the solder pad)



Handling after soldering

Mechanical stress (e.g. pulling the cable) is not allowed. This could lead to delamination of the bonded aluminum on the FR4 board, which negatively affects the quality of the module.

Figure: Delamination of the bonded aluminum



The modules should be treated with extreme caution!

4. Electrical safety

4.1. Electrical connections

4.1.1. Electrical safety

Basic classification of protection classes

Depending on the design of the luminaire, the requirements of different electrical protection classes are satisfied:

- Luminaires in protection class III (also SELV which stands for Safety Extra Low Voltage) have such low internal voltages that a shock current would be inconsequential. AC voltages with an effective value of up to 35 V AC and direct currents up to 60 V DC are referred to as low voltage.
- Protection class II (non-SELV) applies for luminaires with double insulation, with no protective earth, between the mains circuit and the output voltage or metal casing. Even if the luminaires have electrically conductive surfaces, thanks to their insulation they are protected against contact with other live parts.
- Protection class I (non-SELV) applies for luminaires with basic insulation and protective earth. All the electrically conductive casing components are connected via a protective conductor system which is at earth potential.

Basic insulation TALEXXmodule SLE GEN5

The TALEXXmodule SLE GEN5 features basic insulation against earth, i.e., a clearance/creepage distance greater or the same as 3 mm and can be directly assembled on an earthed metal part of the luminaire.

Luminaire with SELV level

When using the LED module SLE GEN5 in combination with a TALEXXconverter in protection class SELV, the SELV level for the luminaire is achieved.
Thanks to SELV voltage, the luminaire can be replaced by an expert without risk.

NOTICE

Classification of the LED driver in SELV and NON-SELV protection classes can be found in the LED driver matrix.

Protection class II luminaires

When using a TALEXXconverter with NON-SELV level, the following measures are essential in order to achieve protection class II:

- Reinforced insulation between TALEXXmodule SLE GEN5 and the luminaire casing, e.g., by means of plastic casing or an additional insulating foil between the luminaire casing and the module.
- Reinforced insulation between the LED driver and luminaire casing, e.g., by means of plastic casing
- Use of double-insulated lines
- Protect all electrical contacts against mechanical contact, this can typically be achieved with optics which cannot be removed

Protection class I luminaires

When using a TALEXXconverter with NON-SELV level, the following measures are essential in order to achieve protection class I:

- Use of metal casing for the luminaire
- Assembly of the TALEXXmodule SLE GEN5 directly on the casing
- Grounding of the LED driver, TALEXXmodule SLE GEN5 and the luminaire itself
- Protect all electrical contacts against mechanical contact, this can typically be achieved with optics which cannot be removed

⚠ DANGER!

The following measures must be followed in order to avoid life-threatening situations:

- Electrical work on a luminaire with protection class I or II (non-SELV) must only be carried out by an electrically skilled person.
- The luminaire must be disconnected from the mains before starting work on it.
- Check the luminaire for damage. If there are any signs of damage, the luminaire must be replaced.

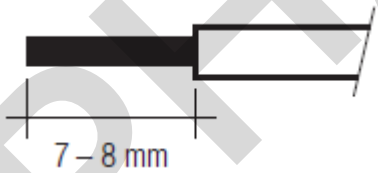
4.1.2. Connections on the LED driver

Wiring type and cross section

The wiring has to be solid cable with a cross section of 0.5 to 0.75 mm² or with flexible cable with soldered ends with a cross section of 0.5 mm².
For the push-wire connection you have to strip the insulation (7-8 mm).

Removing wires by lightly pressing on the push button.

Wire preparation:



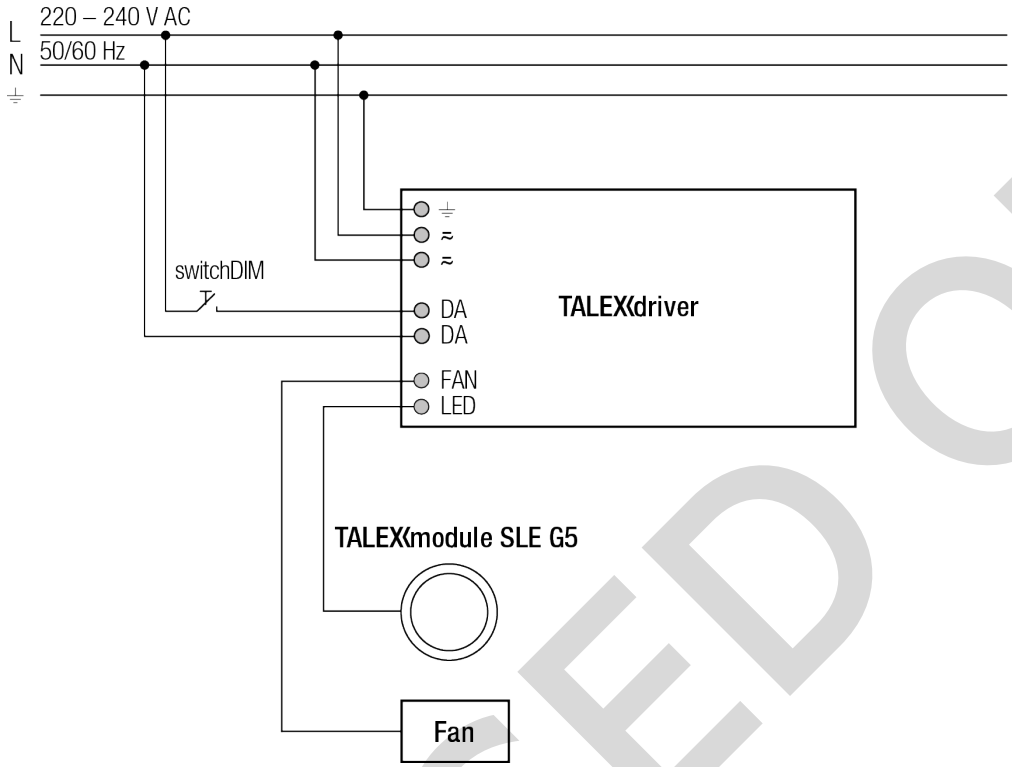
Connections on the LED driver for TALEXXmodule SLE GEN5

Pin	Connection on the TALEXXconverter	Design
⏚	Function earth	Screw terminal
~	Power input 230 – 240 V AC	Screw terminal
~	Power input 230 – 240 V AC	Screw terminal
DA(1)	Control input for DALI / switchDIM	Screw terminal
DA(1)	Control input for DALI / switchDIM	Screw terminal
+FAN	Feed for active cooling	Screw terminal
-FAN	Feed for active cooling	Screw terminal
+LED	TALEXXmodule STARK SLE GEN5	Screw terminal
-LED	TALEXXmodule STARK SLE GEN5	Screw terminal
NTC	Temperature monitoring	Screw terminal
NTC	Temperature monitoring	Screw terminal

(1) Only for LED driver with dimming function

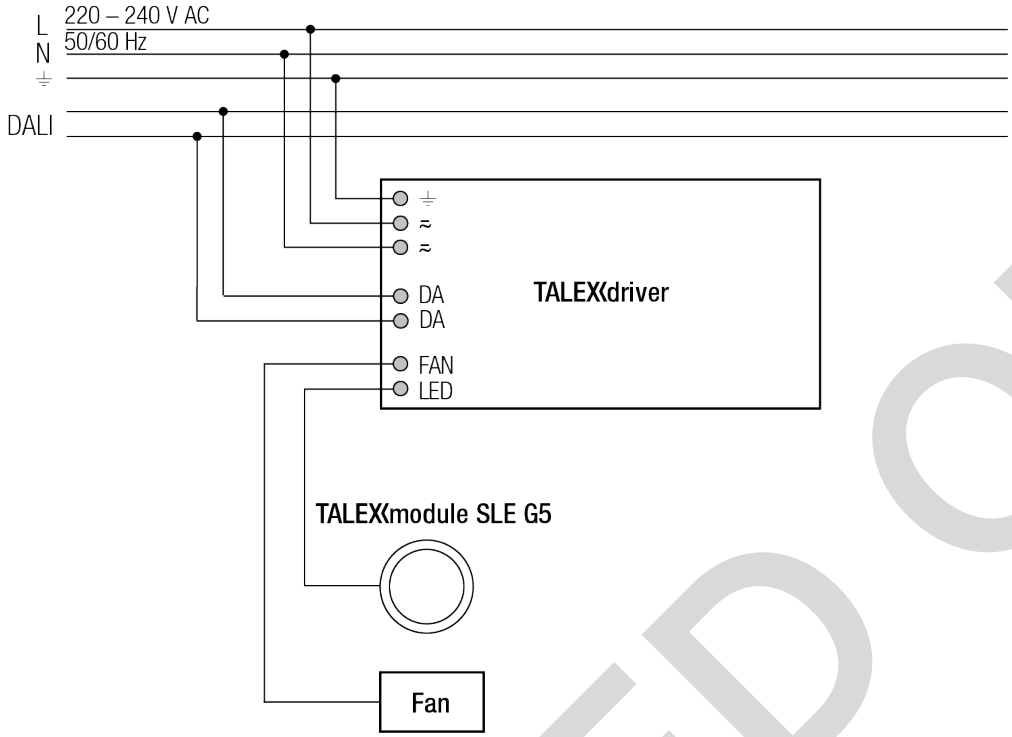
4.2. Wiring diagrams

4.2.1. Wiring diagram for switchDIM for TALEXXengine SLE GEN5 module



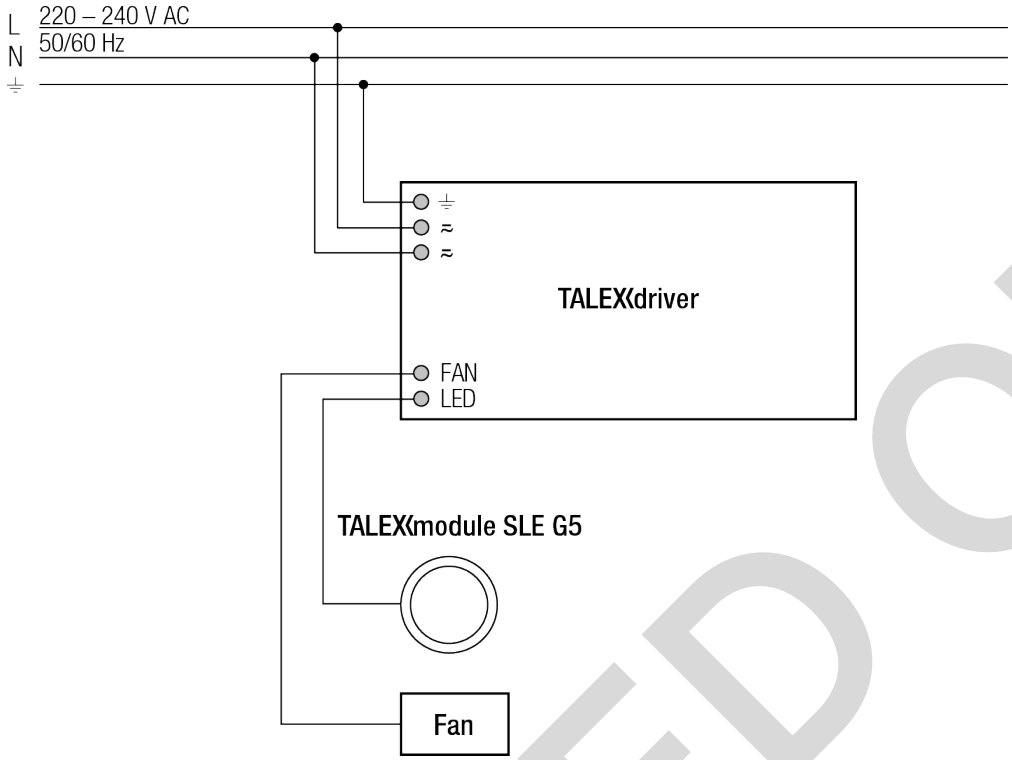
The wiring diagram shows the connection between a LED driver and a TALEXXmodule SLE GEN5 and the connection between the LED driver and the power supply.
The integrated switchDIM function is operated via an appropriate momentary-action switch.

4.2.2. Wiring diagram for DALI for TALEXXengine SLE GEN5 module



The wiring diagram shows the connection between a LED driver with dimming function and a TALEXXmodule SLE GEN5 and the connection between the LED driver and the power supply and the digital DALI signal.

4.2.3. Wiring diagram for ON/OFF via mains for TALEXXengine SLE GEN5 module



The wiring diagram shows the connection between a LED driver without the dimming function and a TALEXXmodule SLE GEN5 and the connection between the LED driver and the power supply.

5. Optical aspects

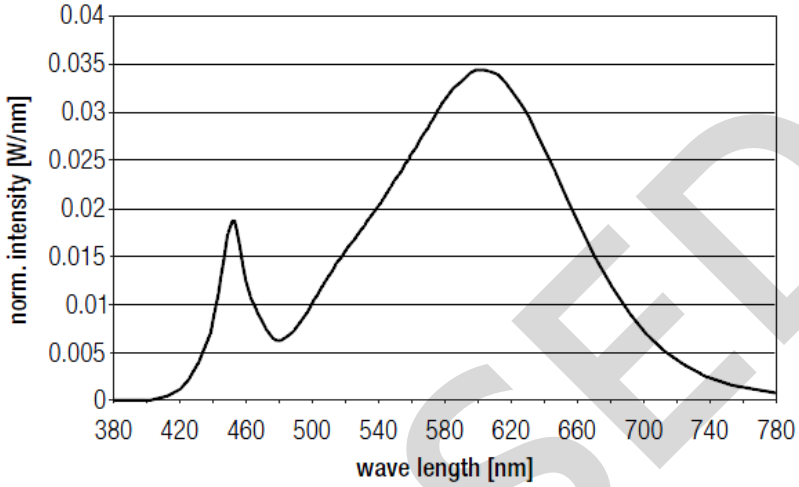
5.1. Colour spectrum

The Dam&Fill technology used in the TALEXX products enables LEDs to be produced in special light colours or colour temperatures. This means that lighting systems can be created that are not only energy-efficient but also have excellent colour rendering.

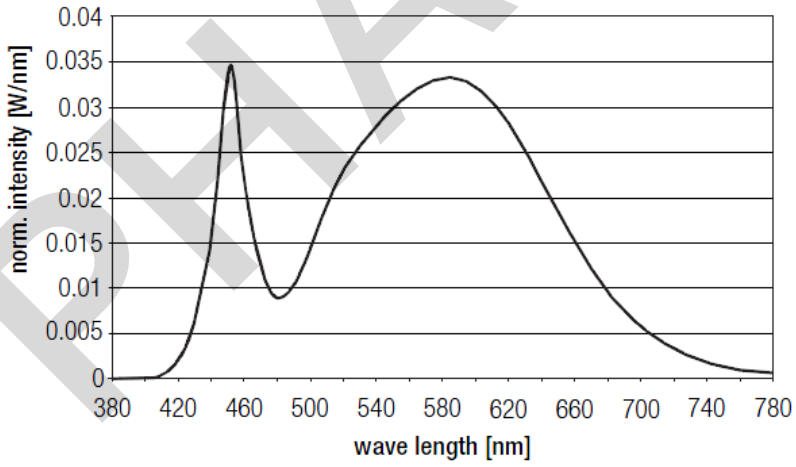
5.1.1. Colour spectrum at different colour temperatures

The diagram shows the normalised intensity in percent over the wavelength in nm at different colour temperatures.

3,000 K



4,000 K



5.2. CRI, Ra and Ri - different colour rendering values

The CRI (colour rendering index) and Ra (arithmetic average) value are different names for the same thing. They are defined as the “effect of an illuminant on the colour appearance of objects by conscious or unconscious comparison with their colour appearance under a reference illuminant”.

CRI and Ra are determined by a test procedure. In this procedure eight colour samples (R1-R8) are illuminated both by the light in question and by a reference light source and the appearance of the samples under the different lights is compared.

If there is no perceivable difference the light in question will be rated with a maximum value of 100. Differences in appearance result in a deduction from the maximum value. The resulting number is the Ri value and describes the colour rendering for one specific colour sample. The average of all eight Ri values is the CRI or Ra value and describes the general colour rendering of the tested light source.

The eight colour samples consist of different pastel colours and can be found in the table below as TCS (test colour samples) 01-08.

There are six more colour samples: R9 to R14 or TCS09 to 14. They consist of different saturated colours and are not used for the calculation of the Ri, Ra and CRI value. However, these colours, especially R9, do have a special importance in the illumination of meat, fish, vegetables and fruit in retail areas.

Name	Appr. Munsell	Appearance under daylight	Swatch
TCS01	7,5 R 6/4	Light greyish red	
TCS02	5 Y 6/4	Dark greyish yellow	
TCS03	5 GY 6/8	Strong yellow green	
TCS04	2,5 G 6/6	Moderate yellowish green	
TCS05	10 BG 6/4	Light bluish green	
TCS06	5 PB 6/8	Light blue	
TCS07	2,5 P 6/8	Light violet	
TCS08	10 P 6/8	Light reddish purple	
TCS09	4,5 R 4/13	Strong red	
TCS10	5 Y 8/10	Strong yellow	
TCS11	4,5 G 5/8	Strong green	
TCS12	3 PB 3/11	Strong blue	
TCS13	5 YR 8/4	Light yellowish pink	
TCS14	5 GY 4/4	Moderate olive green (leaf)	

In the production of modules chips with different wavelengths and chip performances are used.

Because of this, different phosphor mixtures are needed to achieve the required target coordinates and single Ri values can differ between orders. This is not problematic. What is decisive for the overall impression of the LED module is its CRI value. But if specific single Ri values are required for an application, it must be made clear that these values may change for the reasons stated above. It is also not possible to specify tolerances.

Special LED modules are optimised to illuminate a particular product group (for example, MEAT+ is designed for

the illumination of beef). In this case, specifiying the CRI or single Ri values does not make sense. For special LED modules the subjective human perception is the most important factor. The colour coordinates for GOLD, GOLD+, Fresh Meat and MEAT+ are the result of appropriate tests. Single Ri values or the CRI value are not assessed.

5.3. SDCM

The human eye can not only recognize different colours along the black body curve, but also deviations above or below this line. If an LED has a colour temperature of 2,700 K , but is not directly located on the black body curve, it can be perceived as different from another LED with the same colour temperature. To prevent such differences and to assign an LED unambiguously, the chromaticity coordinate must be specified using the x, y coordinates in the colour space chromaticity diagram .

An even more accurate approach is to specify the standard deviation from the target colour, based on levels of MacAdam ellipses. The unit for this is called "SDCM" (abbreviation for "Standard Deviation of colour Matching"). When looking directly into a light source, these differences are perceived more strongly than in a "normal" situation where light is mainly perceived because of its reflections from illuminated surfaces.

Colour differences within one level of the MacAdam ellipses are not visible even when looking directly into the light source. Deviations of two to three levels (<= 3 SDCM) are considered barely perceptible. A value of 3 SDCM is good for LED light sources. For most applications a value of 5 SDCM is still sufficient .

5.4. Binning

Chips and packages from the same production can still show small variations in colour temperature and forward voltage . If the chips are used without pre-selection, these differences can be noticable and interfere with the appearance.

Binning means that the chips and packages are classified according to their colour temperature and forward voltage. This leads to groups of chips or packages that fall into a very narrow window of tolerance. If LED modules are equipped with such chips and packages differences in appearance can be prevented.

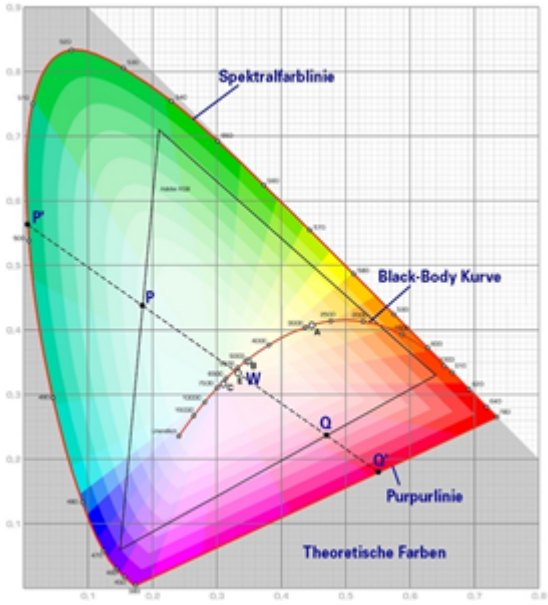
5.5. Secondary Optics

The term Secondary Optics refers to additional optical elements that shape the light output in different forms. Secondary Optics include e.g. reflectors, lenses or covers.

5.6. Coordinates and tolerances (to CIE 1931)

As before, the production process for TALEXX LEDs does without binning. As a result, white LEDs can be produced with normal distribution in the range of a MacAdam-Ellipse 3. Thanks to the proximity to the Planckian curve there are no annoying colour discrepancies.
Every module is automatically tested at the final inspection stage to ensure that all the supplied products fall within the agreed specification.

5.6.1. Chromaticity coordinate



LEDs exhibit variations in terms of their exact shade of colour. This means that different “white” LEDs will all shine in a colour that is within the white colour spectrum. But the colours won’t be exactly the same.

These colour differences between LEDs are problematic in areas where the lighting must produce a specified and uniform colour and deviations from that can impair the visual appearance of an installation. Using the chromaticity coordinate helps to avoid such problems by defining the exact shade of colour of an LED.

Technically speaking, the chromaticity coordinate is defined by its three coordinates (x, y, z) within the so called CIE 1931 colour space chromaticity diagram.
The CIE 1931 colour space chromaticity diagram represents all the colours that are discernible for humans. Since the three coordinates sum up to 1, two coordinates are sufficient to define a colour and so one one coordinate is sometimes left out.

5.6.2. Colour temperature and Black Body Curve

The Black Body Curve within the colour space chromaticity diagram represents the colours that show when a so-called "black body" is slowly heated.

A "black body" is an "idealized" body which absorbs all light and has no reflected radiation.
If a "black body radiator" is slowly heated, it passes through a colour scale from dark red, red, orange, yellow, white to light blue. The definition for the colour temperature of a light source is the temperature where the “black body radiator” shows the same colour.

The colour temperature is measured in Kelvin (K). The most common luminaires have colour temperatures below 3,300 Kelvin (warm white), between 3,300 and 5,300 Kelvin (neutral white) or above 5,300 Kelvin (daylight white).

5.7. Eye safety

The human eye can be damaged if it is directly exposed to a light source. Different light sources pose a hazard:

Risk group	Evaluation
Actinic UV E_S (200 - 400 nm)	Risk group 0 (1)
Near UV E_{UVA} (315 - 400 nm)	Risk group 0 (1)
Blue light L_B (300 - 700 nm)	Risk group 0 (1)
Retina, thermal L_R (380 - 1,400 nm)	Risk group 0 (1)
IR radiation, eye E_{IR}(780 - 3,000 nm)	Risk group 0 (1)

(1) The evaluation of eye safety is based on EN 62471:2008 (photo-biological safety of lamps and lamp systems):

- Risk-free (risk group 0): The LEDs do not pose any photo-biological risk.
- Low risk (risk group 1): The LEDs pose a small risk because of normal limitations.
- Medium risk (risk group 2): The LEDs pose a small risk because of reactions to bright light sources or thermal discomfort.
- High risk (risk group 3): The LEDs pose a risk even with just momentary or temporary exposure.

The risk depends on the size of the light source and its intensity. The risk increases with smaller light sources and higher light intensity.

According to the classification of the LED into certain risk groups luminaire manufacturers must consider different requirements:

Necessary measures	RG 0	RG 1	RG 2	RG 3
Indication of risk group in the data sheet of the LED	x	x	x	x
Indication of risk group on the LED module itself	-	-	x	x
Stating at what distance the LED module falls back into risk group 1	-	-	x	x
Positioning of the luminaire so that direct exposure to the light can be prevented	-	-	x	x

Labeling the luminiare with the following symbol: 	-	-	x	x

The risk group classification for the luminaire is the same as that of the installed LED module.

5.8. Reflector design and beam characteristics

5.8.1. Reflector design

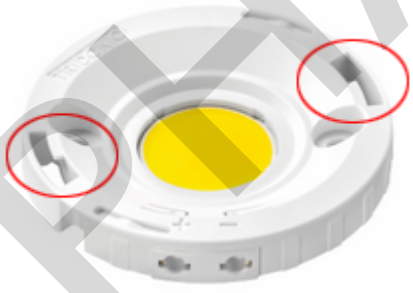
The following description of the reflector installation only applies to the two layers ADVANCED and EXCITE. The ESSENCE layer does not have any housing and is only available as RAW version.

The mechanical and optical properties of the modules of the TALEXXengine SLE GEN5 system offer the best conditions for using reflectors. The new design of the SLE GEN5 housing with its recesses allows for a quick and easy connection of the reflectors via snap-on. The overall efficiency of the system can be optimised by choosing a reflector that directs the light appropriately.

The optical properties (e.g. beam angle) and the dimensions of the reflector play a crucial role:
The overall height of the luminaire can be reduced by selecting a low-profile reflector, depending on the beam angle required. This may improve the thermal output of the luminaire by increasing the height available for the heat sink.

Using a reflector can guarantee a uniform illumination and that the colours are mixed properly. Some reflectors have the option of faceting for the reflector wall.

Reflector installation



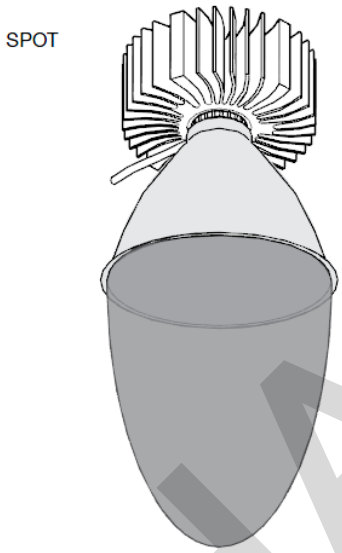
SLE G5 and reflector are connected securely via snap-on. The housing of the SLE G5 has two lateral recesses (see image above), compatible reflectors have matching knobs. Compatible reflectors are listed on the product page of the module.

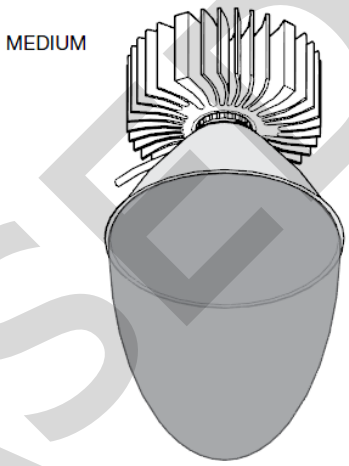
If you want to use a reflector which is not compatible with the SLE GEN5 housing, you can alternatively use an adapter for the connection of the reflector. The adapter is mounted on the housing of the SLE GEN5 module. We recommend the adapter from TE connectivity with article number 2213194-1. The adapter can be ordered from TE connectivity. Distribution via Tridonic is not possible.

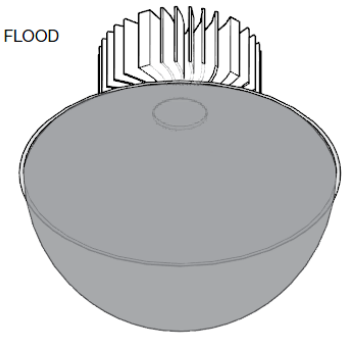
⚠ CAUTION!

Make sure that your reflector is compatible with the adapter.

Examples of reflectors with different beam angles







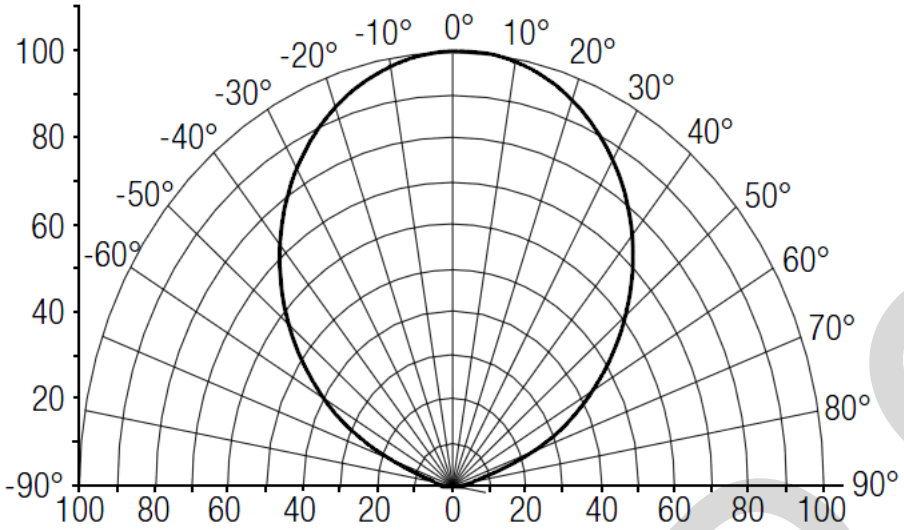
NOTICE

To help create customised designs and to carry out optical simulations CAD data and Rayfiles are available for download from the Tridonic website.

- Go to the produkt page on the Tridonic homepage
- Choose the desired product
- Click on CAD/RAY slide at bottom of the page

5.8.2. Beam characteristics

Maximum relative light intensity Iv/v



5.8.3. Photometric code

Key for photometric code, e. g. 930 / 369

1st digit		2nd + 3rd digit	4th digit	5th digit	6th digit	
		Colour temperature in Kelvin x 100	MacAdam initial	MacAdam after 25% of the life-time (max. 6,000 h)	Luminous flux after 25% of the life-time (max. 6,000 h)	
Code	CRI				Code	Luminous flux
7	70 – 79				7	≥ 70 %
8	80 – 89				8	≥ 80 %
9	≥ 90				9	≥ 90 %

6. Thermal aspects

6.1. Decrease of luminous flux

6.1.1. Lifetime, luminous flux and failure rate

The luminous flux of an LED module decreases over lifetime.

The L-value describes this behaviour. L70 means that the LED-module delivers 70% of the initial luminous flux. This value is always linked to a certain operation time and defines the lifetime of the LED module.

The L-value is a statistical value. The actual reduction of the luminous flux may vary within the supplied LED modules. For this reason, the B-value specifies how many modules fall below the given L-value, e.g.. L70B10 means that 10% of the LED modules fall below 70% or 90% of the LED modules stay above 70% of the initial value.

Additionally, C-value specifies the percentage of total failures.

The F-value describes the linkage of B- and C-value and takes both total failures and degradation into account. L70F10 means that 10% of the LED modules have either shown total failure or fallen below 70% of the initial value.

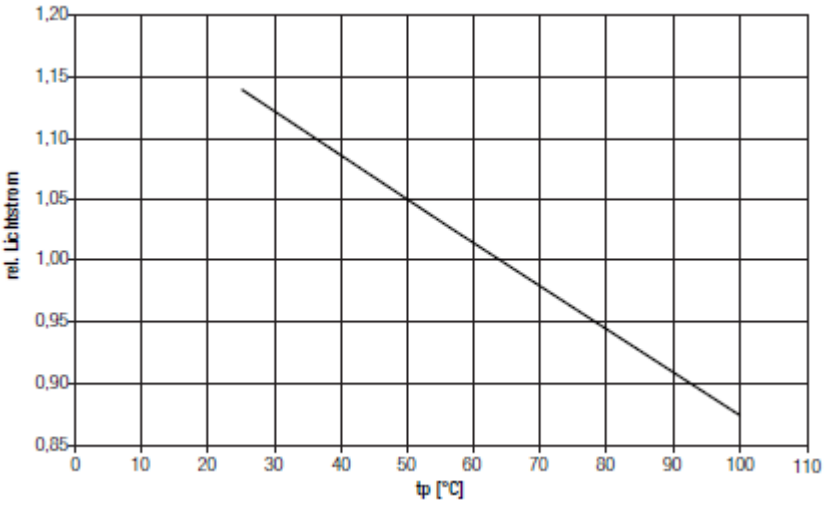
There are two reasons for the limitation of the lifetime data with 60,000 h:

1. The LED modules have been tested for 10,000 hours. According to LM80, it is possible to make a 6-fold extrapolation. The lifetime of the LED modules is by no means limited to 60,000 h. But due to the diversity and the rapid generational changes it is not possible to conduct tests over a period of several hundred hours. Before the tests had been completed, the tested chips were no longer available on the market. Due to the tested data, we can specify 60,000 h. The LED lifetime is certainly higher!
2. The switching cycles of the LED modules must be tested according to standard IEC 62717 / 10.3.3. If a lifetime of 60,000 h is communicated, the LED modules must have been tested for at least 30,000 switching cycles. Our LED modules meet the requirements of standard IEC 62717 / 10.3.3 and have been tested for 30,000 switching cycles.

6.1.2. Effect of cooling on the life of the modules

The life of the module depends to a large extent on the operating temperature. The more that the operating temperature can be reduced by cooling, the longer the expected life of the module. If the permitted operating temperature is exceeded, however, the life of the module will be significantly reduced.

Figure: Lifetime characteristic

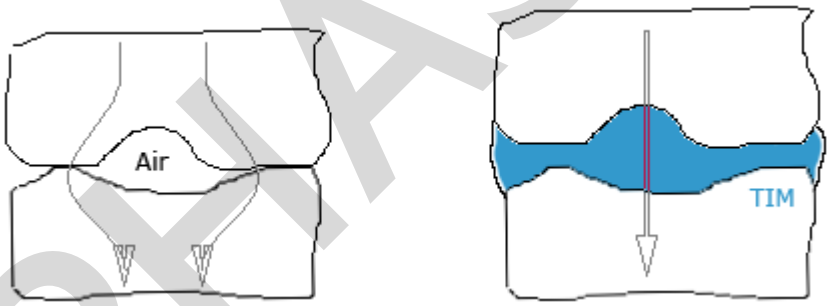


NOTICE

Please check the information on the operating temperature and the requirements for cooling in the module data sheets.

6.1.3. Thermal Interface Material

Figure: Heat transfer without TIM (left) and with TIM (right) (magnified illustration)



Thermal Interface Material (TIM) helps to reduce the thermal impedance between LED module and heat sink and thus improves the heat transfer between the two components.

When LED module and heat sink are joined together, uneven surfaces can be the cause for trapped air. Since air is a thermal insulator trapped air obstructs the heat transfer. TIM replaces the trapped air and improves the heat transfer.

In general:

- The lower the thermal impedance, the better the heat transfer and thus the cooling of the modules

- The thickness of the TIM relates to the unevenness of the surfaces: the more uneven the surface is, the thicker the TIM must be

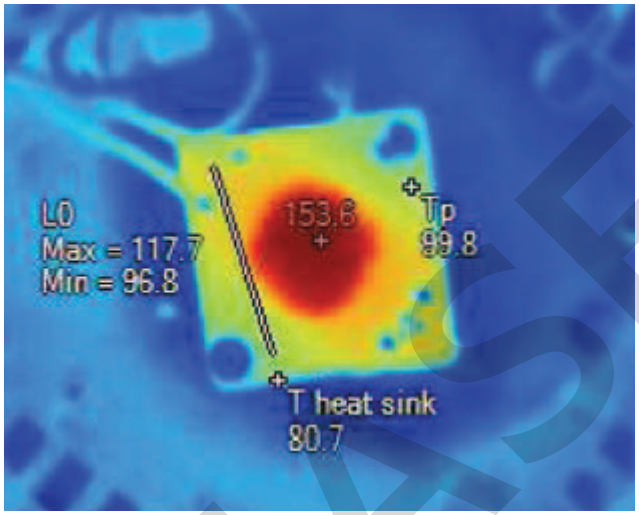
SLE G5 modules with affix "T" will be delivered with pre-assembled thermal pad Tgard 3000.
The bottom side of the thermal pad is glued to the module, the upper side is not adhesive. This makes it easier to position the module when it is connected to the heat sink.

⚠ CAUTION!

The thermal pad is an integral part of the "T" module and must not be confused with a protective foil.
The thermal pad must not pulled off!

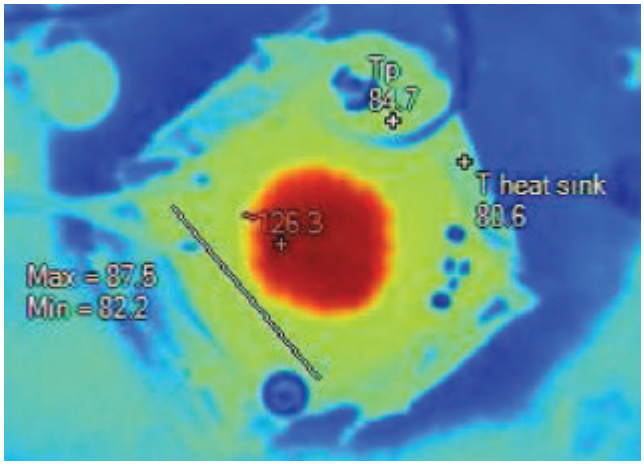
Impact of bending on the thermal behavior

If the thickness of the thermal interface material is in the range of 200µm (which is a common value for TIMs used in general illumination) a moderate torque (0,5nm) applied on the screws, may lead to a bending of the module resulting in a lateral variation of the thermal resistance.



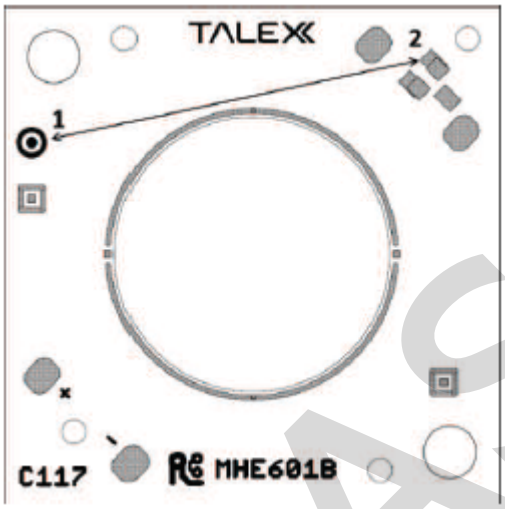
As a result of the bending an offset temperature on the module of more than 20°C is possible.

The same torque applied on a module with a thermal conductive paste as thermal interface material (thickness below 50µm) leads to a significantly decreased bending and a therefore lower silicone temperature.



Recommendation (for application notes)

Mounting quality of the LED-module can be tested by measuring the temperature on opposite points as marked below.



A temperature difference of more than 10°C between Point1 and Point2 signifies a bend in the module.

In which ways can Tridonic SLE modules be mounted to achieve good performance?

- Usage of thin and flexible thermal interface materials. Usage of thermal paste (1W/mK @ 50µm thickness) is strongly recommended.
- Don´t exceed the recommended torque of 0,5nm
- Use heat sinks with smooth surfaces
- Check temperature homogeneity as described above.
- Take maximum silicone temperature as application advice into consideration.

Conclusion

With the increasing power density of LED-modules the thermal management gets more important.

Intelligent heat management can increase the performance and lifetime of an LED-spot-module significantly.

6.1.4. Rth

The lifetime of TALEXX products is highly dependent on the operating temperature. Exceeding the permissible temperature limits results in a significantly reduced lifetime or the destruction of the TALEXXmodule SLE G5. Therefore, it is necessary to mount the TALEXXmodule SLE G5 on an appropriate heat sink, which do not exceed the Rth_{max} value. The Rth values can be found in the data sheet of the respective products. The data sheets can be found on the Tridonic website at the following link: http://www.tridonic.com/com/en/data-sheets.asp

6.1.5. tp point, ambient temperature and lifetime

The temperature at the tp point is crucial for the luminous flux and the lifetime of a TALEXX product.

The thermal limits can be checked at the tp/tc point and the tr point.

- tp is the temperature at which the rated values are obtained.
- tc is the threshold temperature which ensures the security of the module and must not be exceeded under normal conditions.
- tr_{max} specifies the thermal connection of the heat sink and the luminaire for the interchangeability with other Zhaga products.

For the TALEXXmodule SLE G5 tp a temperature of 65 °C must be maintained in order to achieve an optimum between heat sink requirements, luminous flux and lifetime.

Adherence to the permitted tp temperature must be checked under operating conditions in a thermally stable state. For this the max. ambient temperature of the relevant application must be taken into account.

Explanatory note

The actual cooling may deviate due to the material, the design, external and situative influences. A thermal compound between TALEXXmodule SLE G5 and heatsink using thermal paste or thermally conductive adhesive foil is absolutely necessary.

Additionally, in order to optimize the thermal connection, the TALEXXmodule SLE G5 has to be mounted on the heat sink with M3 screws.

The calculation of the heat sink information is based on the use of thermally conductive paste with a thermal conductivity of λ> 1 W / mK and a thickness of max. 50 µm or a thermally conductive adhesive foil with b <50 µmmK/W.

6.1.6. Requirements for the heat sink

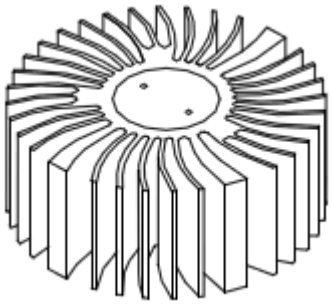
Although the operating temperature of the modules is continually monitored during operation and the power is automatically reduced in the event of excess temperature, the modules should not be operated without a heat sink. The heat sinks must be dimensioned to provide adequate cooling capacity.
The R_{th} value is important for selecting an appropriate heat sink. This value depends on the light output of the module and on the ambient temperature in which the module is to be operated. The R_{th} value of the heat sink must be smaller than the required R_{th} value.

NOTICE

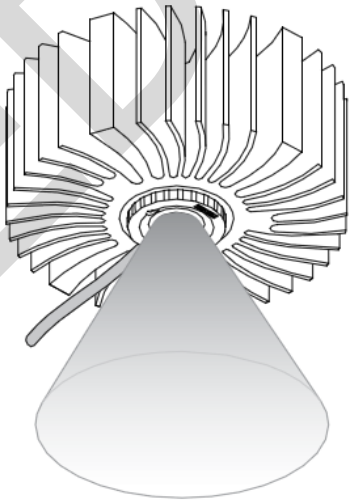
Please check the information on heat sinks in the module data sheets.

6.2. Passive and active cooling

6.2.1. Passive cooling



Passive cooling module



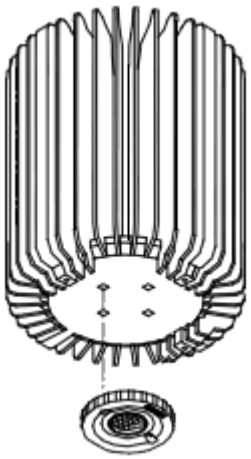
Example of passive cooling for the module

Heat transfer from a heat source to the surrounding cooling medium (e.g. air) depends primarily on the difference in temperature, the effective surface area and the flow rate of the cooling medium. The function of a heat sink is to increase the surface area over which the heat can be dissipated. This lowers the thermal resistance.
A passive heat sink works mainly by convection. The surrounding air is heated, which makes it rise, and is replaced by cooler air.
Heat pipes can be used as an alternative to cooing with fans. If space is particularly tight, the heat is first conveyed away. The actual heat sink is located at the other end of the heat pipe.

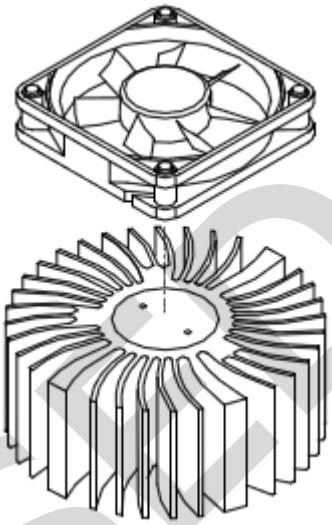
Benefits of passive cooling

- Energy savings
- Silent
- No mechanical wear
- No maintenance

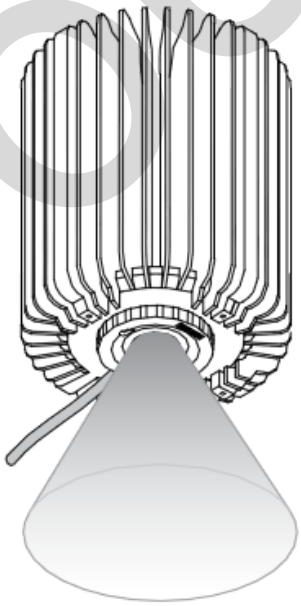
6.2.2. Active cooling



Round active cooling module round



Square active cooling module



Example of active cooling for the module

An active heat sink consists of the heat sink itself and an electrically powered fan. The fan dissipates heat from the heat sink by blowing a sufficient quantity of air along the surface of the heat sink. To reduce the power draw and noise, the fan speed can be controlled from the active cooling system on the basis of temperature.(1) A diaphragm can be used as an alternative to fans to produce active air movements.
Active heat sinks with fan cooling achieve around six times the performance of passive heat sinks for the same amount of material used. Active heat sinks can therefore be made very compact.

(1) The fan speed is not controlled from the TALEXXengine system.

Benefits of active cooling

- Space savings
- Effective cooling
- Professional design

6.3. Fan connection and temperature measurement

6.3.1. Fan driver

Fan drivers drive active heat sinks in order to make sure that the LED modules are sufficiently cooled.

NOTICE

The fan driver must be operated with suitable KTY sensors and wiring!
For more information please consult the corresponding LED driver data sheet.

6.3.2. KTY-Sensor

The Intelligent Temperature Management (ITM) function protects the LED light modules against short-term thermal overloads.

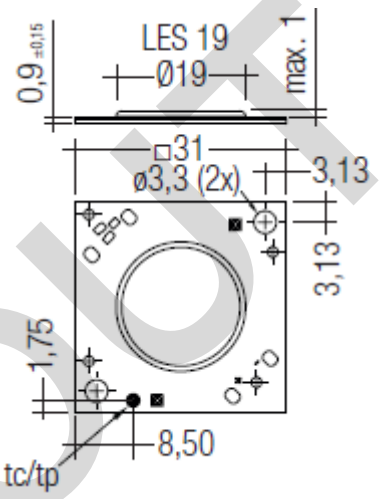
To monitor the temperature of the LED, a silicon-based temperature sensor (KTY81-210, KTY82-210) can be connected to the LED driver.

If certain temperature thresholds are exceeded the LED output is gradually reduced or completely switched off. As a result of this, the dimm level and the temperature decreases. If the temperature falls below the the threshold temperature, the LED driver automatically returns to nominal operation.

The use of an NTC or PTC resistor is not possible. The device can also be operated without sensor (default setting). The function can be adjusted via the masterCONFIGURATOR.

6.3.3. Temperature measurement on the module

The temperature of the module must be measured at the t_c/t_p point. As shown in the drawing of the LES 19 beside the t_c/t_p point is marked on the module. The temperature can be measured with a simple temperature probe. In actual practice, thermocouples (e.g. B & B Thermotechnik thermocouple, K-type) have been successfully used for taking measurements. Such thermocouples can be attached directly to the t_c/t_p point with heat-resistant adhesive tape or a suitable adhesive. The measured values are recorded by an electronic thermometer (e.g. "FLUKE 51", VOLTCRAFT K202 data logger).
The maximum possible temperature must be determined under worst-case conditions (ambient temperature of the luminaire, installation of the luminaire) for the relevant application. Before the measurement is taken the luminaire should be operated for at least 4 hours in a draught-free room.



6.3.4. ta, tp rated, tc max

- ta ... ambient temperature: The ta temperature is the ambient temperature at which the LED module is operated.
- tp rated ... performance temperature: The tp rated temperature is the temperature at which the photometric and electrical data are given. This is the temperature that the LED module has when it is in operation.
- tc max ... max. case temperature: Tc max temperature is the max. temperature that the LED module is allowed to have. The tc max temperature is safety relevant. This is the max. temperature at which the LED module can be operated without compromising security.

6.3.5. Temperature management of the LED driver

To protect the LED module from thermal damage, LED drivers with integrated temperature management automatically dim down if a certain temperature is exceeded.
The temperature at the t_c point on the LED driver can be measured with a simple temperature probe. The t_c point on the LED driver is indicated by a sticker on the casing.

NOTICE

Measurement conditions, sensors and handling are described in detail in standard EN 60598-1 “General requirements and tests for luminaires”.

7. Ordering information and sources

7.1. Article numbers

NOTICE

The TALEXXmodule SLE GEN5 series comprises different variants of modules:

- with housing
- with housing and thermal interface material
- without housing, with or without connection cable

Modules without housing or connection cable have a certain affix in their name:

- Modules without housing have the affix "H" in their name
- Modules with housing and thermal interface material have the affix "H" and "T" in their name
- Modules with connection cable have the affix "C" in their name
- Modules without connection cable have the affix "R" in their name

Modules without housing or connection cable have a certain affix in their name:

- Modules without housing have the affix "PURE" in their name
- Modules without connection cable have the affix "W/O-C" in their name

Abbreviations:

- XD ... Xtreme Density; H ... housing; T ... thermal interface material; C ... cable; R ... raw

The following variants are available:

Module name	Housing	Thermal interface material	Connection cable
with affix "XD", e.g. SLE G5 6mm 1200lm 830 XD R ADV	✗	✗	✗
with affix "H", e.g. SLE G5 19mm 5000lm 830 H ADV	✓	✗	✗
with affix "H" and "T", e.g. SLE G5 19mm 5000lm 830 H ADV T	✓	✓	✗
with affix "C", e.g. SLE G5 19mm 5000lm 830 C ADV	✗	✗	✓
with affix "R", e.g. SLE G5 19mm 5000lm 830 R ADV	✗	✗	✗

7.1.1. TALEXXmodule SLE G5 ADVANCED

Type	Article number	Colour temperature	Housing	Thermal interface material	Connection cable
SLE G5 6mm 1200lm 830 XD R ADV	89602182	3,000 K	no	no	no
SLE G5 6mm 1200lm 840 XD R ADV	89602183	4,000 K	no	no	no
SLE G5 11mm 3000lm 830 XD R ADV	89602174	3,000 K	no	no	no
SLE G5 11mm 3000lm 840 XD R ADV	89602175	4,000 K	no	no	no
SLE G5 15mm 5000lm 830 XD R ADV	89602166	3,000 K	no	no	no
SLE G5 15mm 5000lm 840 XD R ADV	89602167	4,000 K	no	no	no
SLE G5 6mm 1200lm 830 XD C ADV	89602178	3,000 K	no	no	yes
SLE G5 6mm 1200lm 840 XD C ADV	89602179	4,000 K	no	no	yes
SLE G5 11mm 3000lm 830 XD C ADV	89602170	3,000 K	no	no	yes
SLE G5 11mm 3000lm 840 XD C ADV	89602171	4,000 K	no	no	yes
SLE G5 15mm 5000lm 830 XD C ADV	89602161	3,000 K	no	no	yes
SLE G5 15mm 5000lm 840 XD C ADV	89602162	4,000 K	no	no	yes
SLE G5 15mm 2000lm 830 R ADV	89602212	3,000 K	no	no	no
SLE G5 15mm 2000lm 840 R ADV	89602213	4,000 K	no	no	no

SLE G5 15mm 3000lm 830 R ADV	89602194	3,000 K	no	no	no
SLE G5 15mm 3000lm 840 R ADV	89602195	4,000 K	no	no	no
SLE G5 15mm 4000lm 830 R ADV	89602190	3,000 K	no	no	no
SLE G5 15mm 4000lm 840 R ADV	89602191	4,000 K	no	no	no
SLE G5 19mm 5000lm 830 R ADV	89602202	3,000 K	no	no	no
SLE G5 19mm 5000lm 840 R ADV	89602203	4,000 K	no	no	no
SLE G5 23mm 6000lm 830 R ADV	89602206	3,000 K	no	no	no
SLE G5 23mm 6000lm 840 R ADV	89602207	4,000 K	no	no	no
SLE G5 15mm 2000lm 830 C ADV	89602242	3,000 K	no	no	yes
SLE G5 15mm 2000lm 840 C ADV	89602243	4,000 K	no	no	yes
SLE G5 15mm 3000lm 830 C ADV	89602198	3,000 K	no	no	yes
SLE G5 15mm 3000lm 840 C ADV	89602199	4,000 K	no	no	yes
SLE G5 15mm 4000lm 830 C ADV	89602186	3,000 K	no	no	yes
SLE G5 15mm 4000lm 840 C ADV	89602187	4,000 K	no	no	yes
SLE G5 19mm 5000lm 830 C ADV	89602216	3,000 K	no	no	yes
SLE G5 19mm 5000lm 840 C ADV	89602217	4,000 K	no	no	yes
SLE G5 23mm 6000lm 830 C ADV	89602228	3,000 K	no	no	yes
SLE G5 23mm 6000lm 840 C ADV	89602229	4,000 K	no	no	yes
SLE G5 19mm 5000lm 830 H ADV	89602220	3,000 K	yes	no	no
SLE G5 19mm 5000lm 840 H ADV	89602221	4,000 K	yes	no	no
SLE G5 23mm 6000lm 830 H ADV	89602232	3,000 K	yes	no	no
SLE G5 23mm 6000lm 840 H ADV	89602233	4,000 K	yes	no	no

SLE G5 19mm 5000lm 830 H ADV T	89602224	3,000 K	yes	yes	no
SLE G5 19mm 5000lm 840 H ADV T	89602225	4,000 K	yes	yes	no
SLE G5 23mm 6000lm 830 H ADV T	89602236	3,000 K	yes	yes	no
SLE G5 23mm 6000lm 840 H ADV T	89602237	4,000 K	yes	yes	no

7.1.2. TALEXXmodule SLE G5 EXCITE

Type	Article number	Colour temperature	Housing	Thermal interface material	Connection cable
SLE G5 6mm 1200lm 930 XD R EXC	89602184	3,000 K	no	no	no
SLE G5 6mm 1200lm 940 XD R EXC	89602185	4,000 K	no	no	no
SLE G5 11mm 3000lm 930 XD R EXC	89602176	3,000 K	no	no	no
SLE G5 11mm 3000lm 940 XD R EXC	89602177	4,000 K	no	no	no
SLE G5 15mm 5000lm 930 XD R EXC	89602168	3,000 K	no	no	no
SLE G5 15mm 5000lm 940 XD R EXC	89602169	4,000 K	no	no	no
SLE G5 6mm 1200lm 930 XD C EXC	89602180	3,000 K	no	no	yes
SLE G5 6mm 1200lm 940 XD C EXC	89602181	4,000 K	no	no	yes
SLE G5 11mm 3000lm 930 XD C EXC	89602172	3,000 K	no	no	yes
SLE G5 11mm 3000lm 940 XD C EXC	89602173	4,000 K	no	no	yes
SLE G5 15mm 5000lm 930 XD C EXC	89602164	3,000 K	no	no	yes
SLE G5 15mm 5000lm 940 XD C EXC	89602165	4,000 K	no	no	yes
SLE G5 15mm 2000lm 930 R EXC	89602214	3,000 K	no	no	no
SLE G5 15mm 2000lm 940 R EXC	89602215	4,000 K	no	no	no

SLE G5 15mm 3000lm 930 R EXC	89602196	3,000 K	no	no	no
SLE G5 15mm 3000lm 940 R EXC	89602197	4,000 K	no	no	no
SLE G5 15mm 4000lm 930 R EXC	89602192	3,000 K	no	no	no
SLE G5 15mm 4000lm 940 R EXC	89602193	4,000 K	no	no	no
SLE G5 19mm 5000lm 930 R EXC	89602204	3,000 K	no	no	no
SLE G5 19mm 5000lm 940 R EXC	89602205	4,000 K	no	no	no
SLE G5 23mm 6000lm 930 R EXC	89602208	3,000 K	no	no	no
SLE G5 23mm 6000lm 940 R EXC	89602209	4,000 K	no	no	no
SLE G5 15mm 2000lm 930 C EXC	89602244	3,000 K	no	no	yes
SLE G5 15mm 2000lm 940 C EXC	89602245	4,000 K	no	no	yes
SLE G5 15mm 3000lm 930 C EXC	89602200	3,000 K	no	no	yes
SLE G5 15mm 3000lm 940 C EXC	89602201	4,000 K	no	no	yes
SLE G5 15mm 4000lm 930 C EXC	89602188	3,000 K	no	no	yes
SLE G5 15mm 4000lm 940 C EXC	89602189	4,000 K	no	no	yes
SLE G5 19mm 5000lm 930 C EXC	89602218	3,000 K	no	no	yes
SLE G5 19mm 5000lm 940 C EXC	89602219	4,000 K	no	no	yes
SLE G5 23mm 6000lm 930 C EXC	89602230	3,000 K	no	no	yes
SLE G5 23mm 6000lm 940 C EXC	89602231	4,000 K	no	no	yes
SLE G5 19mm 5000lm 930 H EXC	89602222	3,000 K	yes	no	no
SLE G5 19mm 5000lm 940 H EXC	89602223	4,000 K	yes	no	no
SLE G5 23mm 6000lm 930 H EXC	89602234	3,000 K	yes	no	no
SLE G5 23mm 6000lm 940 H EXC	89602235	4,000 K	yes	no	no

SLE G5 19mm 5000lm 930 H EXC T	89602226	3,000 K	yes	yes	no
SLE G5 19mm 5000lm 940 H EXC T	89602227	4,000 K	yes	yes	no
SLE G5 23mm 6000lm 930 H EXC T	89602238	3,000 K	yes	yes	no
SLE G5 23mm 6000lm 940 H EXC T	89602239	4,000 K	yes	yes	no

7.1.3. Suitable controllers

Tridonic offers a comprehensive range of DALI-compatible products. All the devices specified here support DALI Device Type 6 and therefore guarantee effective use of TALEXXengine SLE GEN5.

Product name	Article number
DALI MSensor 02	28000896
DALI SC	24034263
DALI MC	86458507
DALI TOUCHPANEL 02	28000022
DALI x/e-touchPANEL 02	28000005
DALI PS	24033444
DALI USB	24138923

NOTICE

Go to www.tridonic.com to see the current range of products and the latest software updates.

7.2. Product application matrix

Whether you are looking for wide-area lighting or focused accent lighting, our wide range of TALEXX products will help you create an individual atmosphere and highlight specific areas exactly as you want. Our product portfolio includes individual light points, round, rectangular and strip versions. Specially matched operating equipment such as LED driver, amplifiers and sequencers round off the components for a perfect system solution: They guarantee ideal operation and maximum efficiency.

7.2.1. Luminaire application

TALEXXengine	Downlight	Spotlight	Linear / rectangular	Decorative	Surface	Outdoor (street)
TALEXXengine DLE	✅					
TALEXXengine SLE	✅	✅		✅	✅	

7.2.2. Luminaire application

TALEXXmodule	Downlight	Spotlight	Linear / rectangular	Decorative	Surface	Outdoor (street)
TALEXXmodule SPOT	✅	✅		✅	✅	
TALEXXmodule RECTANGULAR						✅
TALEXXmodule EOS	✅	✅	✅	✅	✅	✅
TALEXXmodule STRIP			✅	✅		

For more information and technical data on the entire TALEXX product portfolio go to led.tridonic.com or see our TALEXX catalogue.

7.3. Partners

7.3.1. Heat sinks

Heat sinks with **active and passive cooling** to match the module can be obtained from the following manufacturers:

BRYTEC AG Brytec GmbH
Vierthalerstrasse 5
AT-5020 Salzburg
T +43 662 87 66 93
F +43 662 87 66 97
info@brytec.at

Cooliance GmbH
Im Ferning 54
76275 Ettlingen
Germany
Tel: +49 7243 33 29 734
Fax. +49 7243 33 29 735
info@cooliance.eu

MechaTronix
4 to 6F, No.308 Ba-De 1st Rd.,
Sinsin district, Kaohsiung City 80050,
Taiwan
Tel: +886-7-2382185
Fax: +886-7-2382187
sales@mechatronix-asia.com
www.mechatronix-asia.com

Nuventix
Vertrieb Österreich
EBV Distributor
Schonbrunner Straße 297-307
1120 Wien
T +43 1 89152-0
F +43 1 89152-30
www.ebv.com

SUNON European Headquarters
Sales area manager
Direct line: 0033 1 46 15 44 98
Fax: 0033 1 46 15 45 10
Mobile: 0033 6 24 07 50 49
andreas.rudel@sunoneurope.com

Heat sinks with **active cooling** can be obtained from the following manufacturers:

Francois JAEGLE
NUVENTIX EMEA Sales and Support Director
+33 624 73 4646
PARIS
fjaegle@nuventix.com

Heat sinks with **passive cooling** can be obtained from the following manufacturers:

AVC
Asia Vital Components Europa GmbH
Willicher Damm 127
D-41066 Mönchengladbach
T +49 2161 5662792
F +49 2161 5662799
sales@avc-europa.de

FrigoDynamics GmbH
Bahnhofstr. 16
D-85570 Markt-Schwaben
Germany
+49-8121-973730
+49-8121-973731
www.frigodynamics.com

7.3.2. Heat-conducting foil and paste

Heat-conducting **foil** (e.g. Transtherm® T2022-4, or Transtherm® Phase Change) for thermal connection between the module and a heat sink is available from the following partner:

BALKHAUSEN Division of Brady GmbH
Rudolf-Diesel-Straße 17
28857 Syke
Postfach 1253, 28846, Syke
T +49 4242 692 0
F +49 4242 692 30
angebot@balkhausen.de

Kunze Folien GmbH
Raiffeisenallee 12a
D-82041 Oberhaching
Tel: +49 89 66 66 82-0
Fax: +49 89 66 66 82-10
info@heatmanagement.com

3M Electro&Communications Business
4C, 3M House, 28 Great Jackson St
Manchester, M15 4PA
Office: +44 161 237 6182
Fax: +44 161 237 1105
www.3m.co.uk/electronics

Heat-conducting **paste** (e.g. Silicone Fluid Component) for thermal connection between the module and a heat sink is available from the following partner:

Shin-Etsu Chemical Co. Ltd.
6-1, Ohtemachi 2-chome
Chiyoda-ku
Tokyo 100-0004
Japan

7.3.3. LED housing

LED housing is available from the following partner:

A.A.G. STUCCHI s.r.l. u.s.
Via IV Novembre, 30/32
23854 Olginate LC
Italy
Tel: +39.0341.653.204
Mob: +39.335.611.44.85
www.aagstucchi.it

7.3.4. Reflector solutions and reflector design

Reflector solutions and support for reflector design are available from the following partners:

ALMECO S.p.A.
Via della Liberazione 15
Tel: +39 02 988963.1
Fax: +39 02 988963.99
info.it@almecogroup.com

Alux-Luxar GmbH & Co. KG
Schneiderstrasse 76
40764 Langenfeld
Germany
T +49 2173 279 0
sales@alux-luxar.de

Jordan Reflektoren GmbH & Co. KG
Schwelmerstrasse 161-171
42389 Wuppertal
Germany
T +49 202 60720
info@jordan-reflektoren.de

KHATOD
OPTOELECTRONIC
Via Monfalcone, 41
20092 Cinisello Balsamo (Milan)
ITALY

Tel: +39 02 660.136.95
Fax: +39 02 660.135.00
Christian Todaro
Mobile: +39 342 8593226
Skype: todaro_khatod
c.todaro@khatod.com
www.Khatod.com

LEDIL OY
Tehdaskatu 13
24100 Salo, Finland
F +35 8 2 7338001

7.3.5. Tridonic sales organisation

The complete list of the global Tridonic sales organisation can be found on the Tridonic homepage at address list.

7.3.6. Additional information

Go to www.tridonic.com to find your personal contact at Tridonic.

Further information and ordering data:

- TALEXX catalogue at www.tridonic.com menue Services > Literature > Catalogue
- Data sheets at www.tridonic.com menue Technical data > Data sheets
- Certificates at www.tridonic.com menue Technical data > Certificates