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Technical Design-in Guide

TALEXengine QLE PREMIUM

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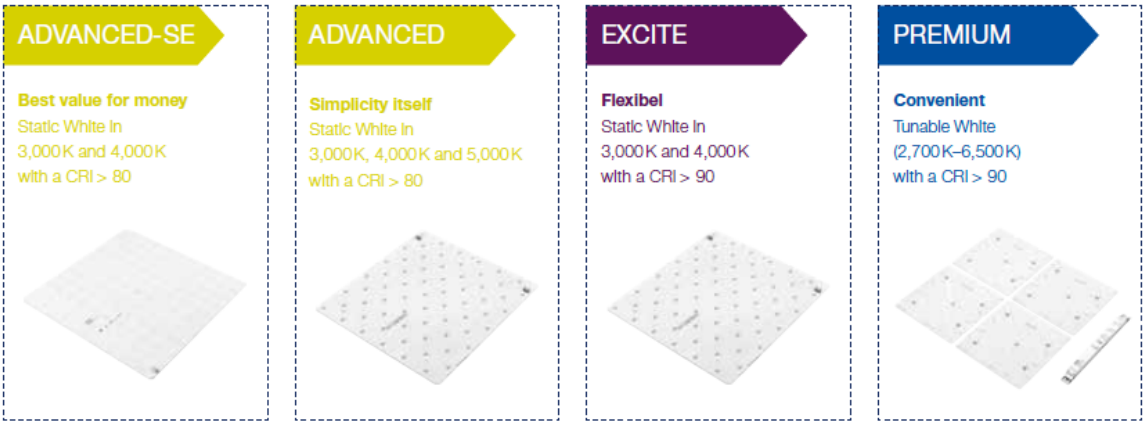
1. Introduction

This design-in-Guide covers the Tunable White System TW QLE PREMIUM from Tridonic.
The Tunable White System provides optimum quality of light in offices, educational and care facilities.

The product portfolio is divided into the following variants:



The Tunable White System is available in two versions:

TW QLE G1 270mm 4x1250lm 830-860 PRE KIT	TW QLE G1 270mm 1250lm 827-865 PRE
	
The kit consists of an LED Driver and 4 QLE PREMIUM modules which are calibrated with each other when shipped.	Single QLE PREMIUM module with two channels, equipped with 2,700 and 6,500 K packages.

The design-in-Guide provides all the information needed to set up a luminaire with the TW QLE PREMIUM system and to adapt it to its requirements.

This includes:

- The selection of compatible LED Drivers for the single module solution

- The set up of the luminaire in regards to thermal and mechanical requirements

2. System overview

2.1. Complete system solution

The use of LEDs in general lighting has great advantages: They are versatile in their application, highly energy-efficient and virtually maintenance free. With the Tunable White QLE PREMIUM system you get perfectly coordinated components from one source: 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. Module variants

NOTICE

The Tunable White QLE PREMIUM series includes different variants:

- available as a complete system consisting of 4 QLE PREMIUM LED modules and a DT8 LED Driver
- available as a single module consisting of individual QLE PREMIUM modules

Abbreviations:

- TW QLE G1 270mm 4x1250lm 830-860 PRE KIT ... complete system of 4 QLE modules and a DT8 LED Driver
- TW QLE G1 270mm 1250lm 827-865 PRE ... single module

The Tunable White QLE PREMIUM series is available in different versions:

	TW QLE KIT	TW QLE
Product version	Complete system with LED Driver and 4 QLE PREMIUM modules	Single QLE PREMIUM module
Image		
Main features	» Static white with a > 80 » long lifetime » high lm/W system efficiency	» Static white with a CRI > 80 » long lifetime » high lm/W system efficiency
Available variants	System consisting of 4 QLE PREMIUM modules and a DT8 LED Driver	Single module
Dimensions	270mm x 270mm	270mm x 270mm
Colour temperature	Tunable White, with adjustable colour temperature from 3,000 to 6,000 K at constant	SMT packages with 2,700 and 6,500 K
Luminous flux (1)	approx. 1,250 lm per module	approx. 1,250 lm per module
Colour rendering / colour tolerance	CRI 80 MacAdam 3 SDCM	up to CRI 80 MacAdam 3 SDCM
System efficiency (1)	up to 132 lm/W	
Module efficiency		up to 156 lm/W
Lifetime (2)	50,000 h	50,000 h
Warranty	5-year guarantee	5-year guarantee

(1) Values at t_p=45°C, all values apply to tp rated

(2) relating to L70/B50

2.2.1. Type code for modules

The following type code is used to identify the modules:

Type code for Type code for TW QLE G1 270mm 4x1250lm 830-860 PRE KIT

	TW	QLE	G1	270mm	4x1250lm	830-860	PRE	KIT
Meaning	Tunable White	Square Light Engine	Gene-ration 1	Size	4 1250lm LED module	Colour tempe-rature range	Variant: PREMIUM	Set consisting of module and LED Driver

Type code for TW QLE G1 270mm 1250lm 827-865 PRE

	TW	QLE	G1	270mm	1250lm	827-865	PRE
Meaning	Tunable White	Square Light Engine	Generation 1	Size	1250lm LED module	Packages on the LED board	Variant: PREMIUM

2.3. LED Driver for the KIT variant

Dimming	Dimming method	PWM
	PWM frequency	200 - 500 Hz
	Dimming range	10 – 100 %
	DALI DT8 / DSI	yes
	switchDIM	yes
Output current	Tolerances	+/- 5 %
Functions & Performances	Standby losses	< 0,3 W
	Rated supply voltage	220 – 240 V
	Lifetime	up to 50.000 h
	Failoure rate	0,1 % / 1.000 h
	Temperature range	-25 °C to +55 °C
	Warranty	5 years

2.3.1. Type code LED Driver

The following type code is used to identify the modules:

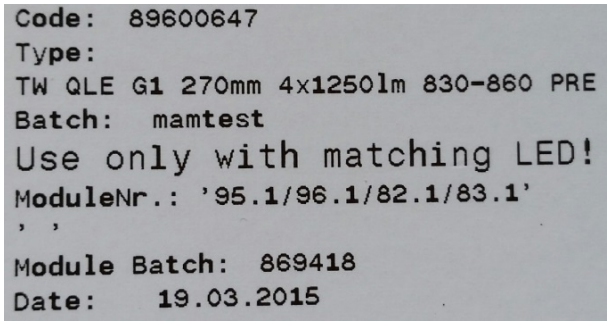
Type code for LED driver LCAI 75W 250mA TW lp

Reference	LCAI	75W	250mA	TW	lp
Meaning	LED Driver for constant current	Power	Output current	Variant: Tunable White	Housing: "low profile"

The precise type designation for the LED Driver is given on the type plate on the LED Driver.

⚠ CAUTION

The TW QLE PRE KIT components form a matched and calibrated unit. Therefore it is not allowed to separate and operate the components in different combinations!
There is a label on the TALEXXconverter LCAI 75W 250mA TW lp with the corresponding module information.



2.3.2. Operating functions for the PREMIUM KIT

Settings of the PREMIUM KIT

The TW QLE PREMIUM KIT offers a wide range of settings for colour temperature and dimming level. Different controllers are available. The controllers are connected directly to the LED Driver.

ⓘ NOTICE

The factory preset for colour temperature is 3,000 K, the factory preset for light intensity is 100%.

2.3.3. Central control via the LED Driver

Control via DALI or a switchDIM switch is achieved by connecting these devices to the LED Driver.

Control via DALI

⚠ CAUTION!

The control line must be installed in accordance with the relevant directives on low voltage.

ⓘ NOTICE

The control input is protected against polarity reversal and against accidental connection to mains voltage up to 264 V AC.

For DALI control the LED modules are digitally controlled via the DALI signal (16-bit Manchester Code).

The predefined colour temperatures and dimming level can be changed via DALI.

Control via switchDIM

A conventional double push button switch can be used for control via switchDIM. One of the push buttons is used to set the colour temperature, the other to set the dimming level.

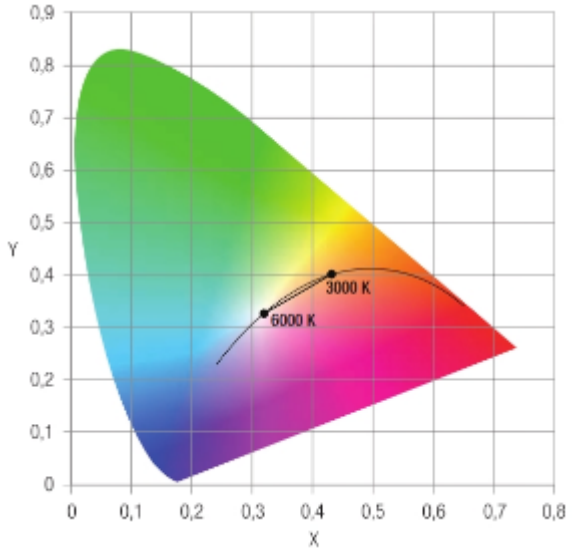
⚠ CAUTION!

Push buttons with glow lamps affect the switchDIM, colourTEMPERATURE functions and should therefore not be used for this purpose.

For control via a switchDIM switch different settings can be made:

- Setting for the colour temperature via colourTEMPERATURE mode with 7 predefined values between 3,000 K and 6,000 K with 500K steps
- Stepless setting for the dimming level between 10% and 100%.

colourTEMPERATURE mode



Location of the colour temperatures along the Planckian curve

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.000 K	3.500 K	4.000 K	4.500 K	5.000 K	5.500 K	6.000 K

NOTICE

Once the maximum value has been reached, the next press takes you directly back to the minimum value. The change from maximum to minimum value is indicated by brief flashing of the LED module.

Changing predefined colour temperatures and dimming levels

The predefined colour temperatures and dimming levels in colourTEMPERATURE mode can be changed via the masterCONFIGURATOR. Any fixed values within the two limit values of 3,000 K and 6,000 K can be selected for the colour temperature.
Adjustments could be in the minimum range step of 100 K. Up to 7 scenes can be individually defined. They can then be recalled via DALI and switchDIM.

A DALI environment is needed for the configuration (power supply, DALI USB). For more information on the procedure see the masterCONFIGURATOR handbook.

Setting the dimming level

The dimming level is set with the other of the two push buttons.

- Press the push button briefly (approx. 1 s) to switch the LED Driver on or off
  → The last values set for the colour temperature and the dimming level will be recalled when the LED Driver is switched on again
- Hold down the push button (> 1 s) to change the dimming level

NOTICE

The dimming direction changes automatically with each dimming operation.

Synchronising the dimming level

Synchronising involves setting all the connected LED modules to a uniform dimming level and a uniform dimming direction.

- Hold down the pushbutton (> 10 s) to synchronise all the connected devices to a uniform colour temperature and a uniform dimming level

2.4. Compatibility between LED module and LED Driver

NOTICE

The descriptions about "Compatibility between LED module and LED Driver" only apply to the single module solution (TW QLE), but not to the complete system (TW QLE KIT).

To control the single module solution you must use a two-channel LED Driver with DALI DT8 capabilities or two DALI DT6 Drivers .

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

2.4.1. 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. continue... → ↓
	Max. DC forward current	≥	Output current + tolerances	

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	

2.4.2. Electrical supply/choice of LED Drivers

The QLE PREMIUM module is a 2-channel LED module with two different LED packages.

The LED packages have a colour temperature of 2,700 and 6,500 K. They can be driven independently of each other. This makes it possible to generate colour temperatures in the intermediate range. The LED packages can be driven by a DALI DT8 2-channel driver or 2 units of a DALI DT6 Driver. The data listed in the “specific technical table” in the data sheet apply per channel.

TALEXXmodule QLE from Tridonic are not protected against overvoltages, overcurrents, overloads or short-circuit currents. Safe and reliable operation can only be guaranteed in conjunction with an LED Driver which complies with the relevant standards. The use of TALEXXdriver from Tridonic in combination with TALEXXmodule QLE guarantees the necessary protection for safe and reliable operation.

If an LED Driver other than Tridonic TALEXXdriver is used, it must provide the following protection:

- Short-circuit protection
- Overload protection
- Overtemperature protection

⚠ CAUTION!

TALEXXmodule QLE must be supplied by a constant current LED Driver. Operation with a constant voltage LED Driver will lead to an irreversible damage of the module.

Wrong polarity can damage the TALEXXmodule QLE.

With parallel wiring tolerance-related differences in output are possible (thermal stress of the module) and can cause differences in brightness. If one module fails, the remaining modules may be overloaded.

2.4.3. Selection of the LED Drivers

TALEXXmodule QLE can be operated either from SELV LED Drivers or from LED Drivers with LV output voltage.

⚠ CAUTION!

TALEXXmodule QLE are basic isolated up to 500 V against ground 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 500 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.

2.4.4. 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

ⓘ NOTICE

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

2.5. Standards and directives

2.5.1. 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"

2.5.2. Standards and directives for LED Driver

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

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

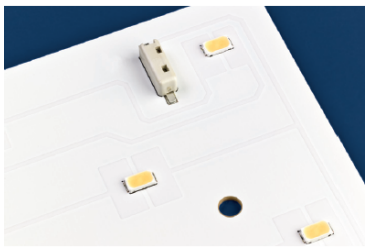
The QLE PREMIUM modules were tested with severity level 4. The guideline for installation can be taken from the ESD document .

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

Depending on the particular situation, the LED Driver can be installed in the luminaire casing (in-built) or outside the casing (remote).

		
Clamping for quick and easy wiring	Homogeneous light even when several LED modules are used together	Unobtrusive wiring thanks to cable penetration and cable return

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

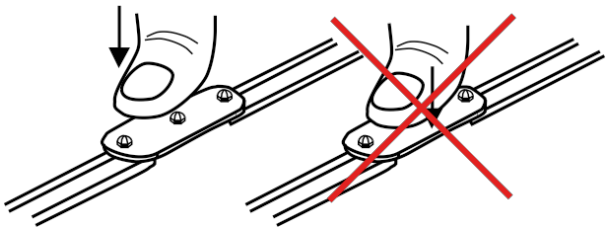
TALEXX modules contain electronic components that are sensitive to mechanical stress. Such stress should be kept to an absolute minimum. In particular the following mechanical stresses should be avoided as these may cause irreversible damage:

- 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.

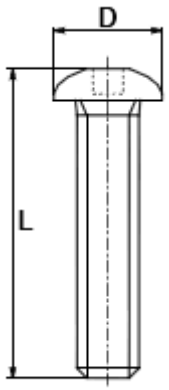
3.1.2. Installing the modules

The modules are mounted on a heat sink with 2 bolts per module. In order not to damage the modules only rounded head screws and an additional plastic flat washer should be used.

The bolts should be selected on the basis of the following dimensions:

Dimensions of the fastening bolts

Bolt size	M4
Max. diameter D	7 mm
Min. length L	5 mm
Max. length L	Depending on the design of the luminaire and the heat sink
Max. torque	0.5 nm



4. Electrical aspects

4.1. Electrical safety

4.1.1. 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 (also extra-low voltage and weak current).
	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.

4.1.2. Basic insulation of TALEXXmodule STARK QLE

The TALEXXmodule STARK QLE 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.

4.1.3. Design measures for satisfying protection class requirements

Not all the components of the TALEXXmodule STARK QLE system comply with the SELV standard. The voltages can thus be greater than 60 V DC.

4.1.4. Luminaire with SELV level

When using the LED module STARK QLE CLASSIC 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.

4.1.5. 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 module STARK QLE CLASSIC 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

4.1.6. 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 STARK QLE CLASSIC directly on the casing
- Grounding of the LED Driver, TALEXXmodule STARK QLE 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.

4.2. Electrical safety and connection

4.2.1. Electrostatic safety and EMC protection

The LED modules are tested up to a voltage of 8 KV static discharging. Depending on the ambient conditions, appropriate precautionary measures must be taken in order to avoid higher voltages, for example during production or installation.

For good EMC conduct, the lines should be run separately from the mains connections and lines. The maximum secondary line length on the terminals is 2 metres.

4.2.2. Electrical supply and selection of the LED Driver

⚠ CAUTION!

TALEXXmodules STARK QLE are not protected against overvoltages, overcurrents, overloads and short-circuit currents!
Safe and reliable operation of the LED modules can only be guaranteed in conjunction with a LED Driver which complies with the relevant standards.

TALEXXmodules STARK QLE must be supplied by a constant current LED Driver. Operation with a constant voltage LED Driver leads to irreversible damage to the modules! Wrong polarity can damage the TALEXXmodules STARK QLE. If a wire breaks or a complete module fails in the case of parallel wiring, the current passing through the other modules increases. This may reduce the service life considerably.

4.3. Electrical connections

4.3.1. TALEXXmodule QLE PREMIUM connections

The LED Driver is connected to the power supply and the connections of the control lines and the LED module via push-in and spring terminals:

Line cross-section and stripped length of the insulation on the LED module

- Permissible line cross-section: 0.4 - 0.75 mm²
- Stripped length of the insulation 6 - 7 mm
- Push-in terminal for solid conductors

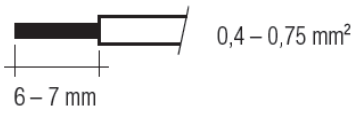
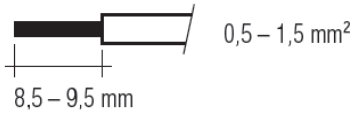
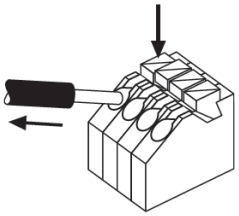
4.3.2. Push-in terminal for solid conductors

Line cross-section on the LED Driver with spring terminal

- Permissible line cross-section: 0.5 - 1.5 mm²
- Stripped length of the insulation 8.5 - 9.5 mm
- Spring terminal for stranded wire with end splice or solid conductor

Spring terminal for stranded wire with end splice or solid conductor

Permissible line cross-sections and stripped insulation lengths of LED Driver with screw terminals can be found in the respective LED Driver data sheets.

		
LED module wire preparation	Converter wire preparation	Spring terminal on the LED Driver

4.4. Connections on the LED Driver

4.4.1. Connections on the LED Driver for TALEXXmodule QLE PREMIUM

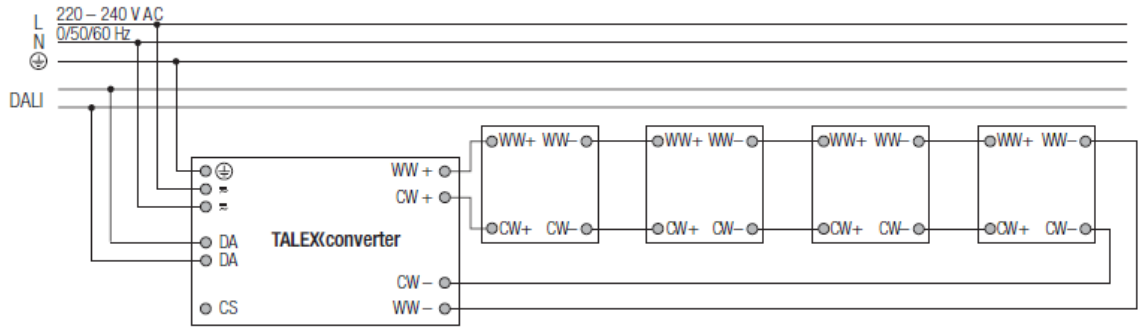
Pin/Connection	Connection on the TALEXXconverter	Design
⏚	Protective earth or functional earth	Spring terminal
~	Power input	Spring terminal
~	Power input	Spring terminal
DA[1]	Control input DALI / DSI / switchDIM / corridor FUNCTION	Spring terminal
DA[1]	Control input DALI / DSI / switchDIM / corridor FUNCTION	Spring terminal
+LED	TALEXXmodules STARK QLE CLASSIC	Spring terminal
-LED	TALEXXmodules STARK QLE CLASSIC	Spring terminal

[1] only with LED Driver with the corresponding functionality

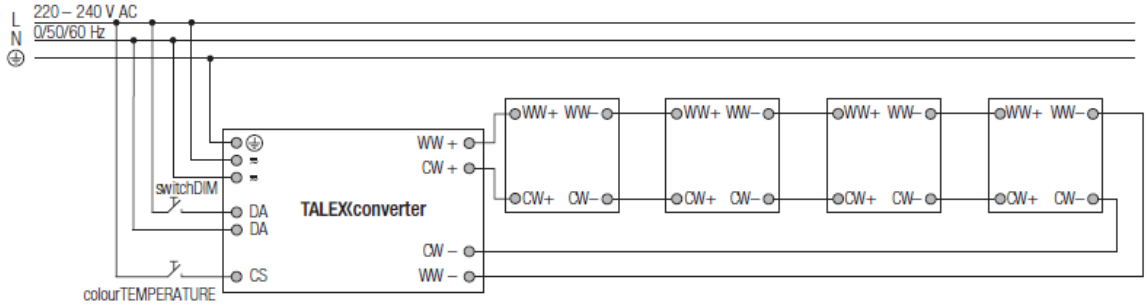
4.5. Wiring diagrams

4.5.1. System solution

Wiring diagram DALI for TALEXXengine QLE PREMIUM KIT

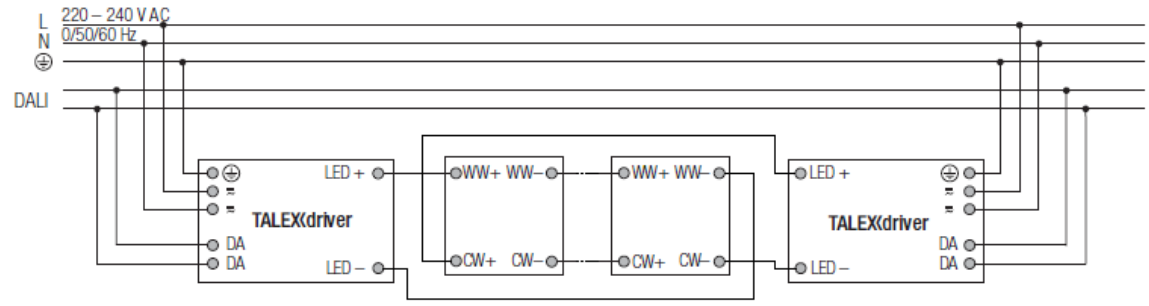


Wiring diagram switchDIM and colourTEMPERATURE for TALEXXengine QLE PREMIUM KIT



4.5.2. Single module solution

Wiring diagram DALI for TALEXXmodule QLE PREMIUM



5. Optical aspects

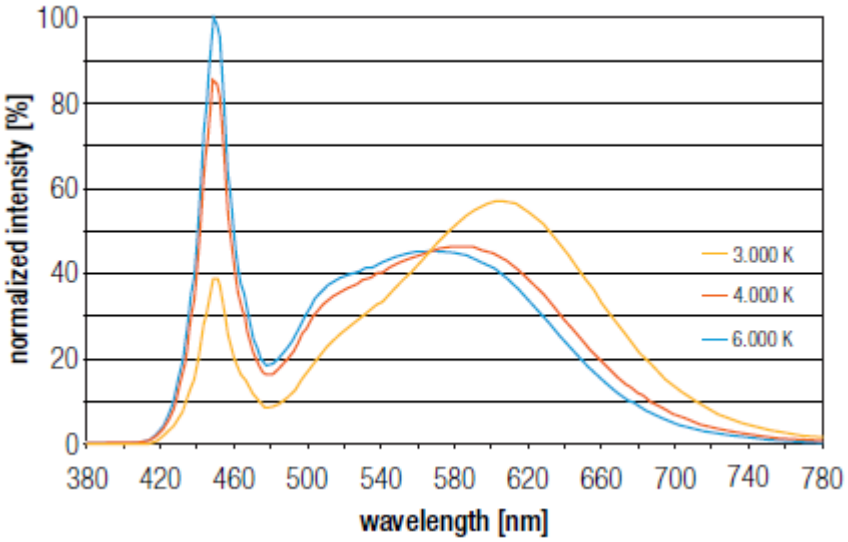
5.1. Colour spectrum

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 for the QLE PREMIUM KIT

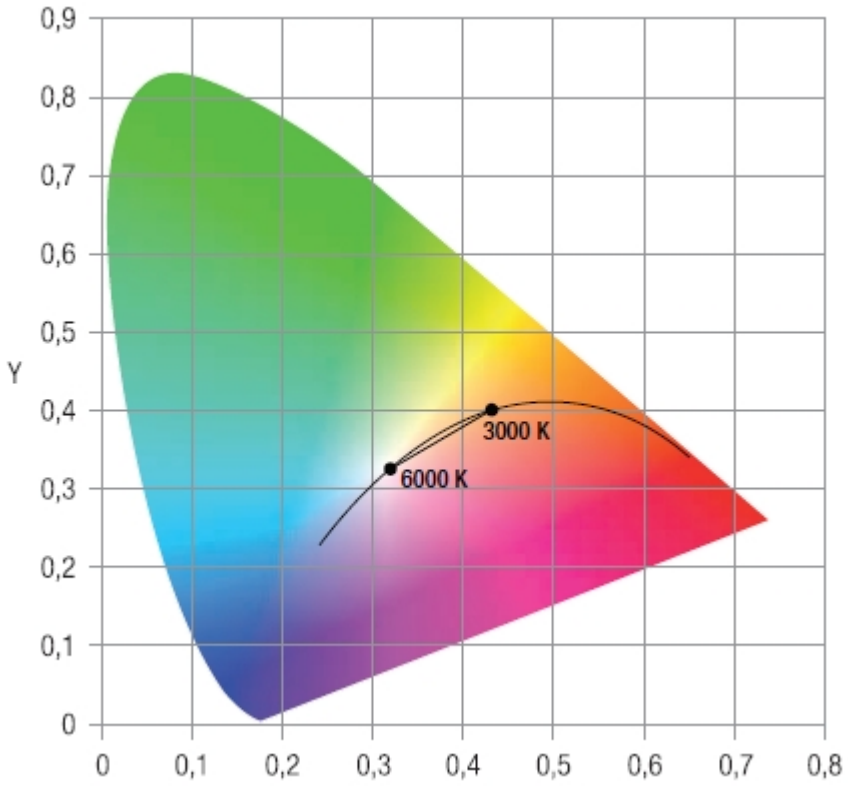
The diagram shows the normalised intensity in percent over the wavelength in nm at different colour temperatures.

3,000 - 6,000 K



5.1.2. 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.

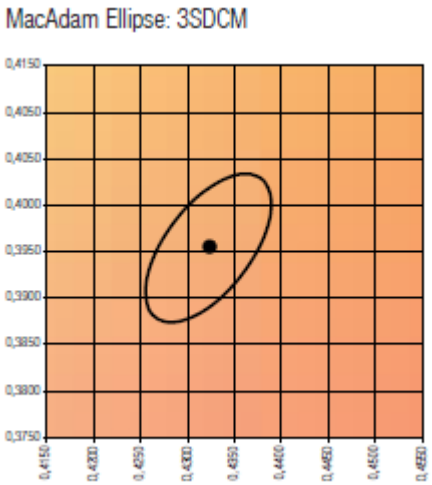


Location of the measuring points along the Planckian curve:

Ambient temperature of the measurement	t_a = 25 °C
Measurement tolerances of the colour coordinates	±0,01

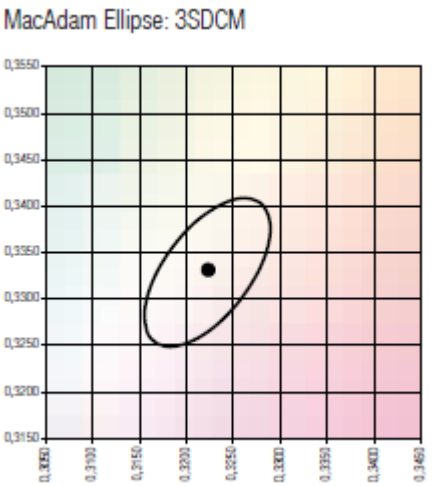
5.1.3. Coordinates and tolerances for TW QLE PREMIUM KIT

MacAdam Ellipse: 3,000 K



	x0	y0
Centre	0,4325	0,3955

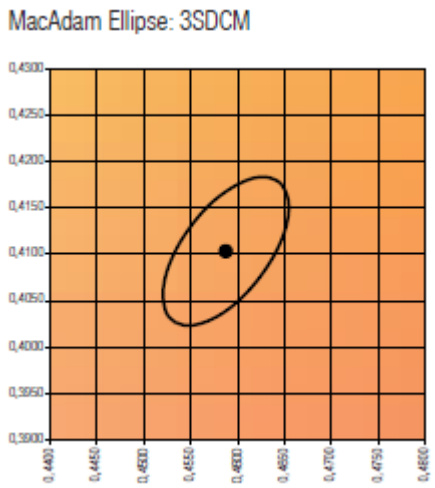
MacAdam Ellipse: 6,000



	x0	y0
Centre	0,3220	0,3330

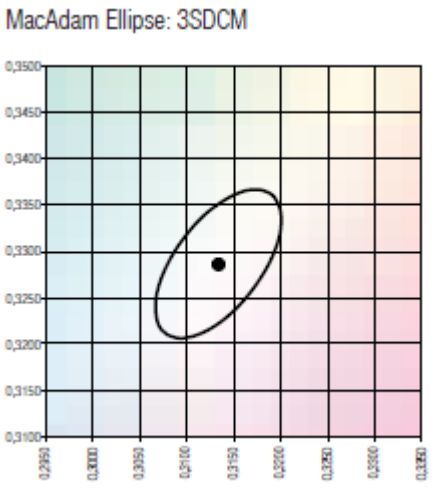
5.1.4. Coordinates and tolerances for QLE PREMIUM single module

MacAdam Ellipse: 2,700 K



	x0	y0
Centre	0,4585	0,4104

MacAdam Ellipse: 6,500 K



	x0	y0
Centre	0,3135	0,3284

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.

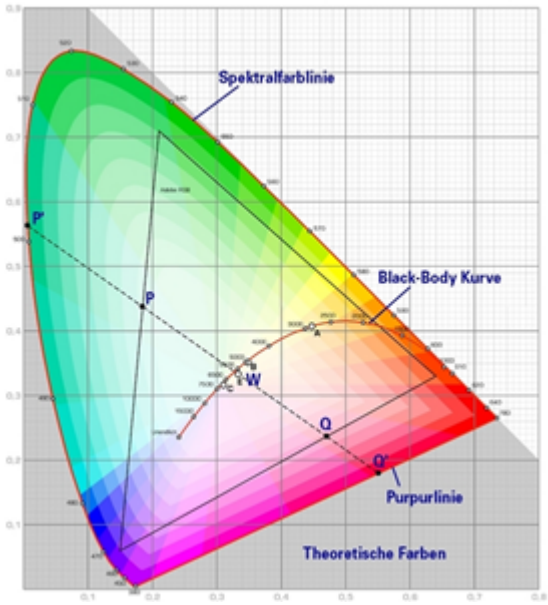
5.5. Secondary Optics

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.

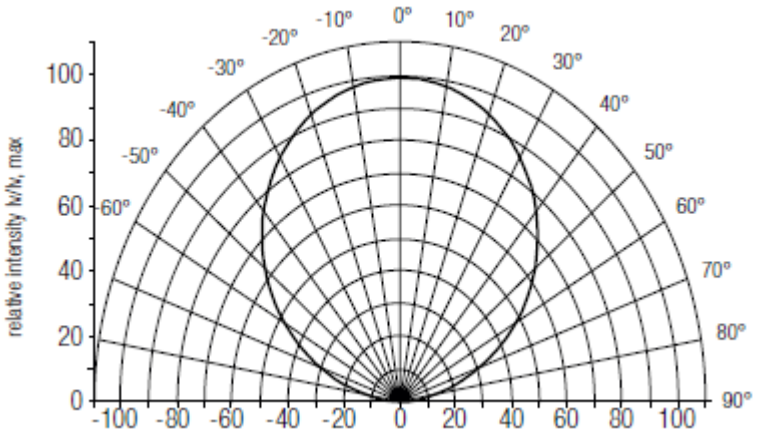
NOTICE

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

5.7.1. Beam characteristics

Maximum relative light intensity Iv/v



5.7.2. Photometric code

Key for photometric code, e. g. 830 / 449

1st digit	2nd + 3rd digit	4th digit	5th digit	6th digit
Code CRI	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 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.

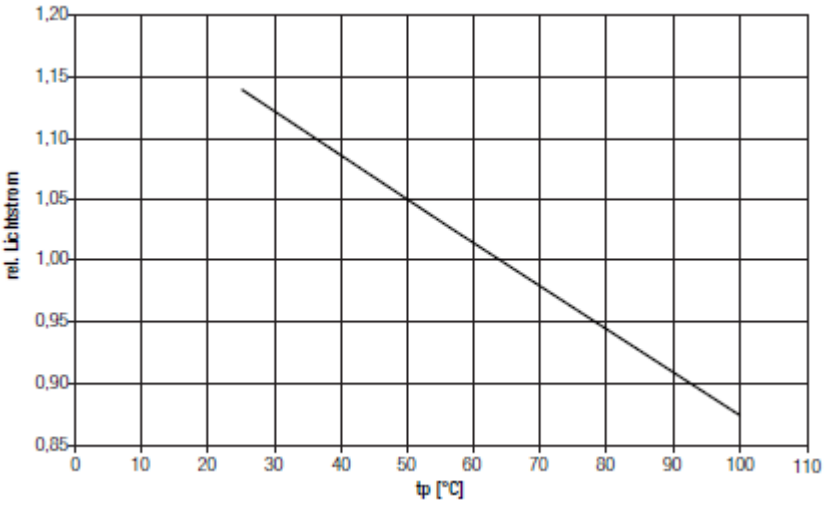
There are two reasons for the limitation of the lifetime data with 60,000 h:

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. 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 G4 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

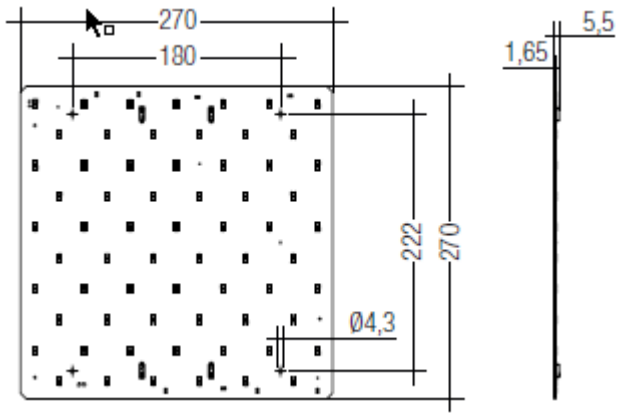
The actual cooling may deviate due to the material, the design, external and situative influences. A thermal compound between TALEXXmodule SLE G4 and heatsink using thermal paste or thermally conductive adhesive foil is absolutely necessary.

Additionally, in order to optimize the thermal connection, the TALEXXmodule SLE G4 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.

6.1.4. 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.



6.1.5. 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.

6.1.6. Temperature management of the LED Driver

To protect the LED module from thermal damage, LED Driver 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 Tunable White QLE PREMIUM series includes different variants:

- available as a complete system consisting of 4 QLE PREMIUM LED modules and a DT8 LED Driver
- available as a single module consisting of individual QLE PREMIUM modules

Abbreviations:

- TW QLE G1 270mm 4x1250lm 830-860 PRE KIT ... complete system of 4 QLE modules and a DT8 LED driver
- TW QLE G1 270mm 1250lm 827-865 PRE ... single module

7.1.1. TALEXXengine TW QLE PREMIUM KIT

Type	Article number	System components
TW QLE G1 270mm 4x1250lm 830-860 PRE KIT	89600647	1 LED-Driver + 4 LED-Module a 1,250 lm

7.1.2. TALEXXmodule TW QLE PREMIUM (single module solution)

Type	Article number	Colour temperature of LED packages
TW QLE G1 270mm 1250lm 827-865 PRE	89600648	2,700 K / 6,500 K

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 GEN4.

Product name	Article number
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.

TALEXXengine application

TALEXXengine	Spotlight	Downlight	Linear lumi-naries	Surface lumi-naires	Recessed floor and wall luminaires	Floor lumi-naires	Street lumi-naires	Deco-rative lumi-naires
TALEXXengine STARK DLE		✅						
TALEXXengine STARK SLE	✅	✅			✅	✅		✅
TALEXXengine STARK LLE			✅	✅	✅	✅		
TALEXXengine STARK QLE				✅	✅			

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