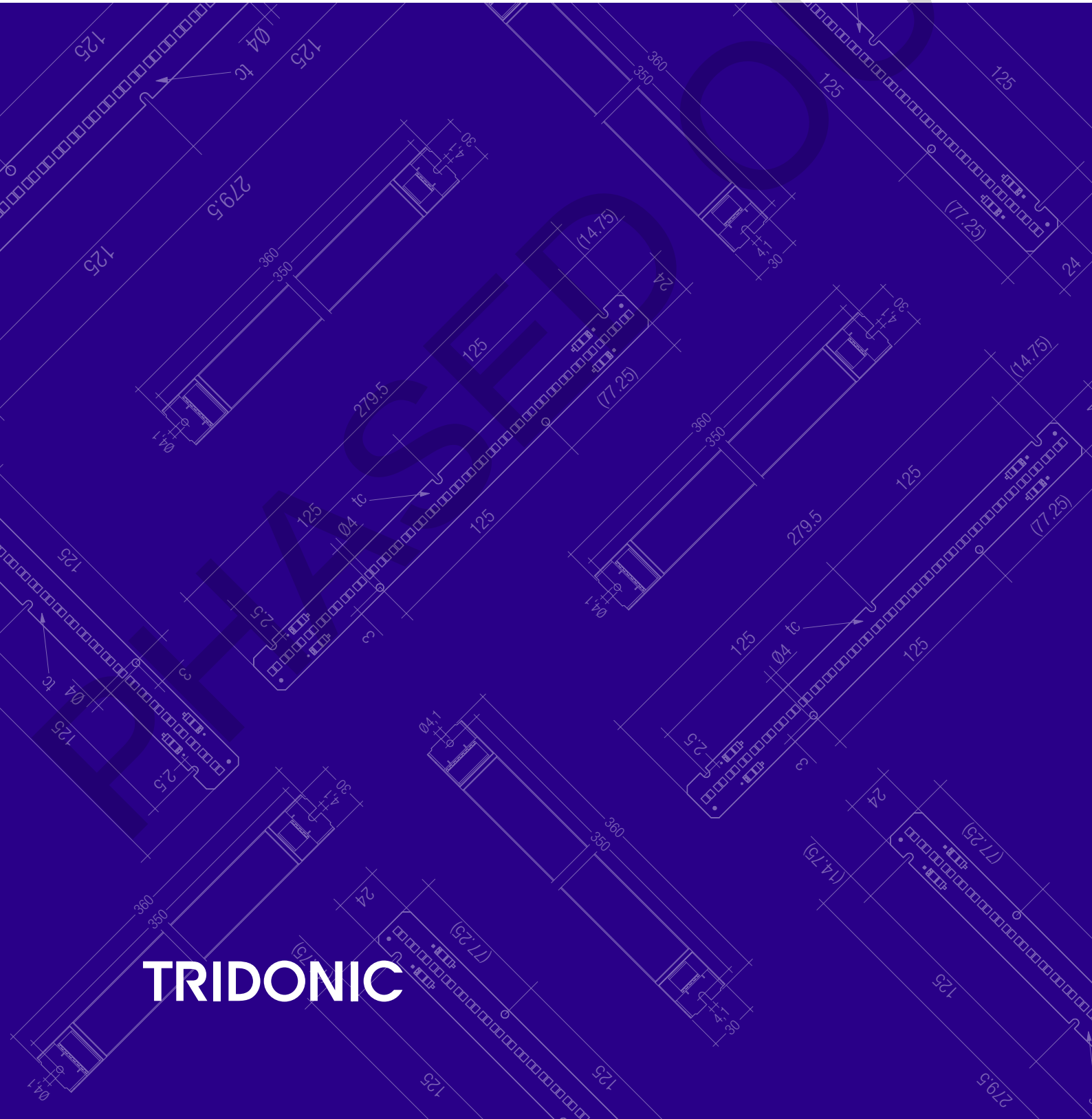
LED Module

# Engine STARK LLE PREMIUM

## Technical Design-In Guide





TRIDONIC

# Table of Contents

## Table of contents

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# 1. Introduction

The versatile system solutions from Tridonic provide the basis for lighting designs that are futureproof, economical and eco-friendly in a wide range of applications. LEDs are showing their strengths in retail outlets, offices, hotels and restaurants.
If you are designing a luminaire to work with LEDs there are certain differences compared to designs with conventional light sources that you need to be aware of. We have written this design guide to help you understand these differences. It answers all the most important questions you may have, such as the right mechanical design, thermal management and optical conditions.

LEDs offer major benefits for general illumination tasks - they are versatile, highly energy-efficient and virtually maintenance-free. With LLE PRE KIT you get a complete system solution for linear and panel lights from a single source, consisting of  perfectly matched components: LED module, LED Driver in a kit package.

LLE PRE KIT offers impressive benefits:

- Lineares Tunable White System with adjustable colour temperature from 3.000 to 6.000 K at contant luminous flux
- High system efficiency up to 106 lm/W at tp=65°C
- Excellent color rendering (CRI > 80)
- Precalibrated set to ensure light quality and high colour consistency, consisting of LED Driver and 3 to 5 LED modules
- Low-Profile LED-Treiber mit digitalem Interface (DALI Device Type 8,DSI,switchDIM, colourTEMPERATURE)
- Linear LED-modules  with 700 or1.500 lm
- Dimming range from 10 – 100 %  without change of colour temperature
- Compliance with the mechanical and electrical standards of the luminaire industry
- Energy efficiency class A

**NOTICE**

**Please note:**

LLE PRE KIT components form a matched and calibrated unit. Therefore it is not allowed to separate and operate the components in different combinations!

All information in this guide has been produced with the most care.
However, the guide is subject to change without notice. Errors and omission excepted. Tridonic does not accept liability for possible damage resulting from the use of this guide.
The latest version of this guide can be found at led.tridonic.com or from your sales partner

# Summary of the chapters

## 2. Summary of the chapters

To make it easier to find your way around the Design-in Guide we have grouped the information on the LLE PRE KIT systems into chapters.
The guide begins with a system overview in which the different versions of the system are presented. The mechanical, electronic, optical and thermal aspects of the components are then described. At the end of the Design-in Guide you will find ordering information and sources.

### 2.1. System overview

The LLE PRE KIT system is available with different properties and functions. The relevant components can be clearly assigned by their type codes.

### 2.2. Mechanical aspects

Depending on the particular situation, the LED Driver can be installed in the luminaire casing (in-built) or outside the casing (remote). Dimensional drawings and installation instructions will help you take account of the requirements of the particular situation.

### 2.3. Electrical aspects

Special Tridonic connecting cable is available to ensure efficient and reliable connection between the modules and the LED Driver.
All the connection options, the connections between the LED Driver and the power supply and the connections of the control lines are shown in relevant wiring diagrams.

### 2.4. Optical aspects

The overall efficiency of the system is improved by choosing a reflector with suitable optical properties (e.g. beam angle) and dimensions.
This chapter provides information to support customer-specific reflector design.

### 2.5. Thermal aspects

The system modules have been designed to operate with a passive or active heat sink and can be mounted directly on such a suitable heat sink.
In the case of active cooling the fan can be connected directly to the module or LED Driver depending on the version.

# Summary of the chapters

## 2.6. Ordering information and sources

The ordering information for the components and the sources for heat sinks, reflectors and accessories can be found at the end of the document.

# 3. System Overview

## 3.1. Overview

| Properties and functions | LLE PRE KIT |
|---|---|
| Colour temperature (1) | 3,000 to 6,000 K<br>Tunable white (controllable and dimmable colour temperatures) |
| Luminous flux | 700 lm or 1,500 lm |
| Colour rendering / colour tolerance | CRI > 80 / MacAdam 3 SDCM |
| System efficiency | 106 lm/W |
| DALI | Device Type 8 (2) |
| switchDIM | yes |
| colourTEMPERATURE | yes |

(1) Application-specific changes to the colour temperature are possible. The colour temperature can be varied from 3,000 to 6,000 K.

(2) The system supports DALI device type 8 to change the colour temperature.

### 3.1.1. Components

A uniform naming concept has been adopted for the components. The system LLE PRE KIT comprises the following components:

_ LCAI LED Driver

_ LLE module

**NOTICE**

LLE PRE KIT must be operated with the calibrated LCAI 38W 125 mA DT8 lp, LCAI 75W 250 mA DT8 lp LED Driver from the set!

### 3.1.2. Efficiency of the modules

The high efficiency of LLE PRE KIT results not only in energy savings but also to a reduction in the thermal load. This means that smaller heat sinks can be used and more compact luminaires can be designed.

### 3.1.3. Area of application

_ All the components of the LLE PRE KIT system comply with the protection requirements of IP20. The system is therefore suitable for indoor applications.

_ LLE PRE KIT complies with system protection class II

## 3.2. Operating functions

LLE PRE 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.

### 3.2.1. Central control via the LED Driver

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

**NOTICE**

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

#### 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 light 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 pushbutton switch can be used for control via switchDIM. One of the pushbuttons is used to set the colour temperature, the other to set the dimming level. Which button has which function is determined during the installation.

**CAUTION!**

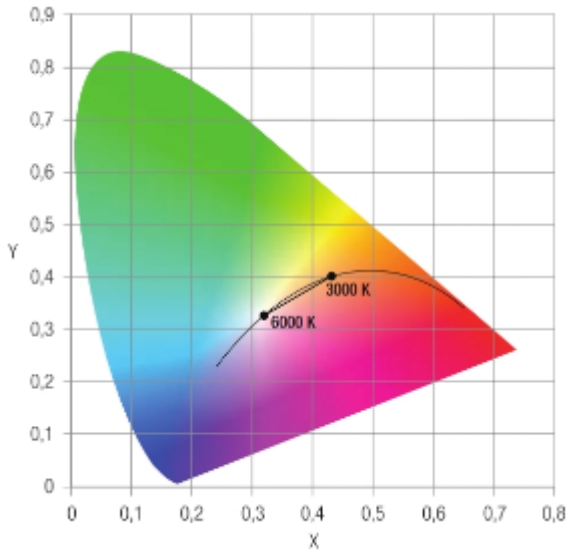
Pushbuttons with glow lamps affect the switchDIM, colourTEMPERATURE functions and should therefore not be used for this purpose.

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 500 K steps
- Stepless setting for the dimming level between 10 % and 100 %.

On start-up the device first activates colour temperature setting in the colourTEMPERATURE mode. The starting values are a colour temperature of 3,000 K and a dimming level of 100 %.

# System Overview




**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 |

### 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. Either a colour value along the Planckian curve can be selected. Up to 16 scenes can be individually defined. These scenes are stored in the LED Driver. 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

_ Select that of the two pushbuttons that is used to set the dimming level

_ Press the pushbutton briefly (< 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 pushbutton (> 1 s) to change the dimming level

**NOTICE**

The dimming direction (fade direction) changes automatically with each dimming operation.

### Synchronising the dimming level

_ Select that of the two pushbuttons that is used to set the dimming level

_ Hold down the pushbutton (> 7 s) to synchronise all the connected devices to a uniform dimming level of 50 %

### Synchronising the colour temperature

_ Select that of the two pushbuttons that is used to set the colour temperature

_ Hold down the pushbutton (> 7 s) to synchronise all the connected devices to a uniform colour temperature of 3,000 K

## Control via a floating pushbutton

For control via a floating pushbutton (make contact) different settings can be made:

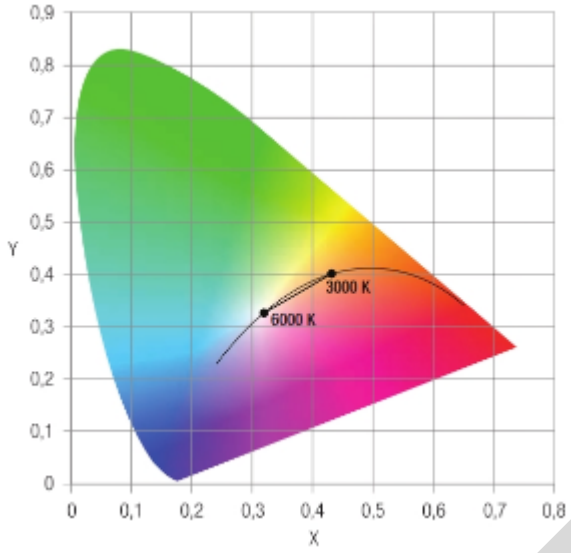
_ Setting the colour temperature via colourTEMPERATURE mode with 7 predefined values between 3,000 K and 6,000 K in 500 K steps

_ Setting the dimming level between 10 % and 100 %.

# System Overview

**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 light module.




**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 |

### Colour temperature set

Adjusting the colour temperature

_ short press on the switch to increase the colour temperature

### Dimmlevel set

_ short press on the switchDIM switch increases or decreases the dimmlevel depending on its orietation

## 3.3. Type codes

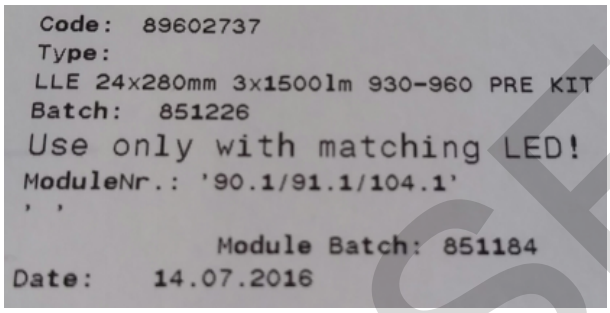
### 3.3.1. Type code for modules

The following type code is used to identify the modules. The table shows reference codes and their meaning for the LLE PRE KIT.

| Reference | LLE | 3x24 | 280 | 700 | 830 - 860 | - | PRE | - | KIT |
|---|---|---|---|---|---|---|---|---|---|
| Meaning | Form | Modules | Length | Luminous flux | CRI 80<br>Colour temperature between 3,000 and 6,000 K | | Version | | Bundled with LMAI |

**⚠ CAUTION!**

The LLE 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 LCAI 38W with the corresponding module information. ##Auf dem LCAI 38W 125mA TW lp oder LCAI 75W 250mA TW lp




### 3.3.2. Type code for LED Driver

The following type code is used to identify the LED Driver:

#### Type code forLED Driver for LCAI 38W 125mA or example

| Reference | LCAU | 38W | / | 125mA |
|---|---|---|---|---|
| Meaning | LED Driver, constant current | Power in W | | current in mA |

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

## 3.4. Versions

### 3.4.1. LLE PRE KIT

The LLE PRE KIT system is packed with completely new functions such as tunable white. The colour temperature can be changed smoothly between 3,000 K and 6,000 K to meet the specific needs of the relevant application.

#### Characteristics:

_ A colour temperature between 3,000 K and 6,000 K that can be set along the Planckian curve
_ Different functions packed in a system for individual lighting solutions
_ Constant colour temperature over the entire dimming range
_ Constant luminous flux
_ Lumen values: 700 lm or 1,500 lm
_ Colour rendering index CRI > 80
_ Very small MacAdam 3 SDCM colour tolerance
_ System efficiency of up to 106 lm/W with high energy savings
_ Temperature monitoring

#### Control functions:

_ DALI Device Type 8
_ switchDIM
_ colourTEMPERATURE

## 3.5. Standards and directives

### 3.5.1. Standards and directives for modules

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

#### CE

| Name | Description |
|---|---|
| 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

| Name | Description |
|---|---|
| 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

| Name | Description |
|---|---|
| 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;<br>Main section 2: Recessed luminaires |
| EN 62471:2008 | Photo-biological safety of lamps and lamp systems |

# Standards and directives

### Safety and performance

| Name | Description |
|---|---|
| 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

| Name | Description |
|---|---|
| EU Regulation No: 874/2012 | "Energy labelling of electrical lamps and luminaires" |

## 3.5.2. Standards and directives for LED Driver

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

### EMI

| Name | Description |
|---|---|
| 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

# Standards and directives

## Safety

| Name | Description |
|---|---|
| EN 50172 2005 | Safety lighting systems |

## DALI

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

# 4. Mechanical aspects

## 4.1. Installation

### 4.1.1. Installation details

**NOTICE**

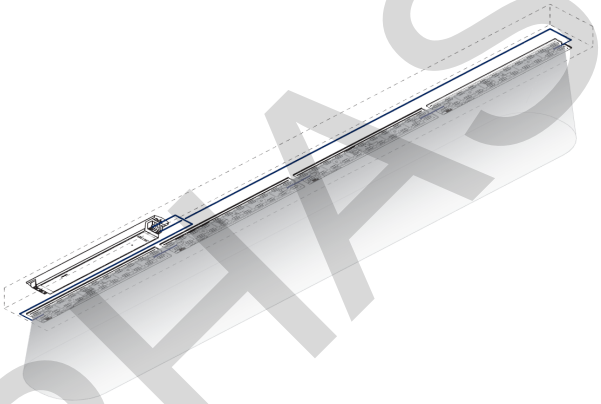
**EOS/ESD safety guidelines**
The device/module contains components that are sensitive to electrostatic discharge and may only be installed in the factory and on site if appropriate EOS/ESD protection measures have been taken. No special measures need be taken for devices/modules with enclosed casings (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:

_ www.tridonic.com/com/en/download/technical/Guideline_EOS_ESD_en.pdf

_ www.tridonic.com/com/en/technical-docs.asp

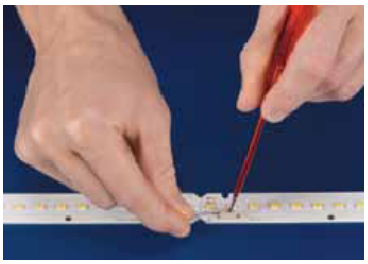
### Installation example with LLE control gear and serial wiring



Installation version IN-BUILT serial wiring with LCAI 38W 125mA TW lp

### Installation details

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



Terminals with push button for quick and easy wiring.

Perfectly uniform light, even if several LED modules are used together.

Beveled edges for discreet wiring and easy installation.

## 4.1.2. Notes on installation

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

_ Adequate distance from insulating materials
_ Adequate strain relief for closed covering on the LED Driver
_ Adequate cooling of the modules (the maximum temperature at the $t_p$ point must not be exceeded)
_ Unrestricted exit of light from the modules

# Mechanical Aspects

## Protection measures against damage

### Mechanical stress

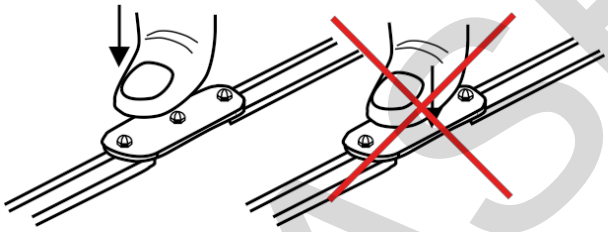
LLE PRE modules contain electronic components that are sensitive to mechanical stress. Such stress should be kept to an absolute minimum. In particular the following mechanical stresses should be avoided as these may cause irreversible damage:

_ Pressure
_ Drilling,
_ Milling,
_ Breaking,
_ Sawing,
_ and similar mechanical processing.

### Compressive stresses

The components of the LLE PRE 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 LLE PRE 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 color 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:

# Mechanical Aspects

_ 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)

**HINWEIS**

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.

# Mechanical Aspects

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<br>_ sulfuric acid<br>_ nitric acid<br>_ phosphoric acid | _ cleaner<br>_ cutting oils |
| Organic acids | _ acetic acid | _ RTV silicones<br>_ cutting oils<br>_ degreaser<br>_ adhesives |
| Alkalis | _ ammonia<br>_ amines<br>_ sodium hydroxide | _ detergents<br>_ cleaner |
| Organic solvents | _ ethers (e.g. glycol )<br>_ ketones (e.g. Methylethylketon )<br>_ aldehydes (e.g. formaldehyde)<br>_ aromatic hydrocarbons (e.g. xylene and toluene) | _ cleaner<br>_ benzine<br>_ petroleum<br>_ paints and varnishes |
| VOC (volatile organic compounds) | _ acetate<br>_ acrylates<br>_ aldehydes<br>_ serve | _ super glue<br>_ all-purpose glue<br>_ screw locking varnish<br>_ coatings<br>_ paints and varnishes |
| Mineral oils | _ hydrocarbons | _ machine oil<br>_ lubricants |

| | | |
|---|---|---|
| Vegetable oils and synthetic oils | _ siloxanes<br>_ fatty acids | _ silicone oils<br>_ linseed oil<br>_ fats |
| Harder, vulcanizer | _ sulfur compounds | _ seals<br>_ sealants<br>_ colors |

### 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

## Instructions for cementing LLE PRE 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 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 module.

### Additional information

LLE PRE 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

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

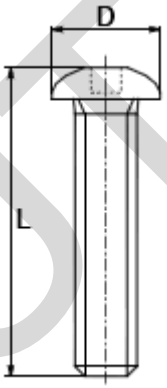
## 4.1.3. Installation of the modules on the heat sink

The LED modules are mounted onto a heat sink with 2 screws per module. For optimal thermical connection it is recommended to use all fastening holes (e.g. 5 screws for the LLE24). In order not to damage the modules only rounded head screws and an additional plastic flat washer should be used.
Suitable screws should be selected on the basis of the following dimensions:

# Mechanical Aspects

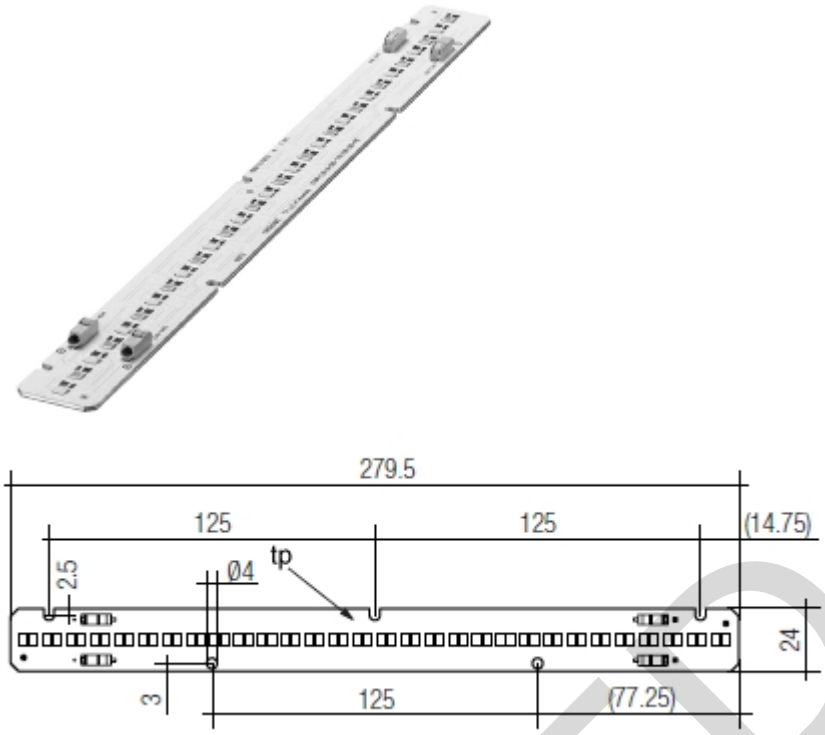
## Dimensions of the fastening screws

| Parameters | Value |
|---|---|
| Bolt size | M4 |
| Max. diameter D | 7 mm |
| Min. length L | 5 mm |
| Max. length L | Depending on the design of the luminaire |



# Mechanical Aspects

## 4.2. Dimensional drawings modules

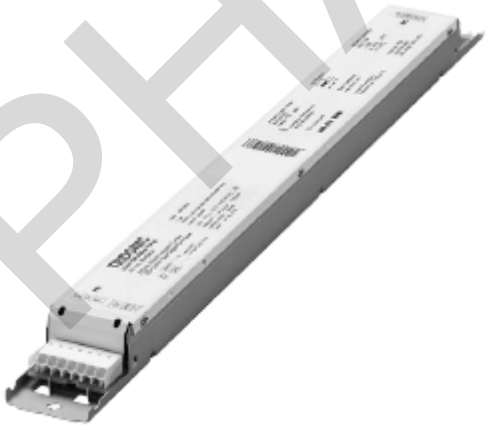



Dimensional drawing of the LLE PRE module

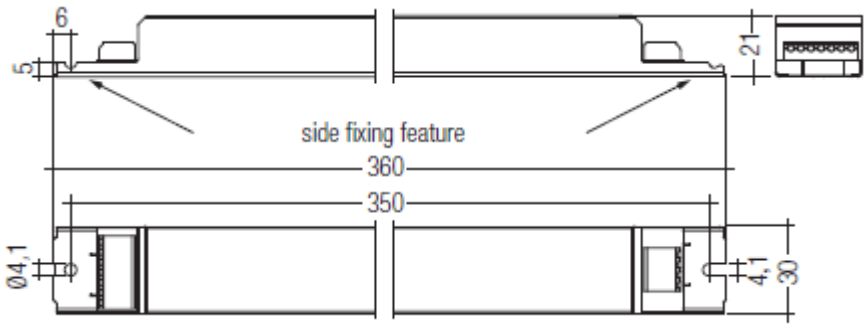
**NOTICE**

CAD data for the modules can be downloaded from the Tridonic homepage (www.tridonic.com) and the relevant product page.

## 4.3. Dimensional drawings LED Driver



# Mechanical Aspects




LED Driver for LLE PRE

**NOTICE**

Detailed information and CAD data for the LED Driver can be downloaded from the Tridonic homepage ( www.tridonic.com) and the relevant product page.

# 5. Electrical aspects

## 5.1. Electrical safety

### 5.1.1. 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 50 V AC and direct currents up to 120 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.

### 5.1.2. Basic insulation of LLE PRE modules

The LLE PRE module 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, also in operation with LCAI 38W 125mA TW lp

### 5.1.3. Design measures for satisfying protection class requirements

Not all the components of the LLE PRE KIT system comply with the SELV standard. The voltages can thus be greater than 120 V DC.

### 5.1.4. Protection class II luminaires

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

- Reinforced insulation between LLE PRE module 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

### 5.1.5. Protection class I luminaires

When using a LLE control gear 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 LLE PRE module directly on the casing

_ Grounding of the LED Driver, LLE PRE module 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.

## 5.2. Electrical safety and connection

### 5.2.1. 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.

### 5.2.2. Electrical supply and selection of the LED Driver

**⚠ CAUTION!**

LLE PRE module 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.

LLE PRE module 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 LLE PRE module. 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.

## 5.3. Electrical connections

### 5.3.1. LLE PRE module 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

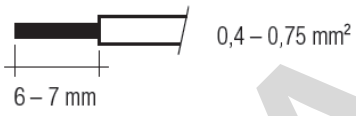
### 5.3.2. Push-in terminal for solid conductors

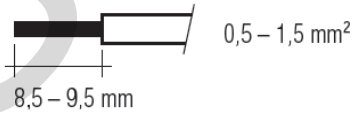
#### Line cross-section on the LED Driver with spring terminal:

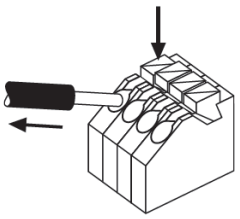
_ Permissible line cross-section: 0.5 - 1.5 mm²
_ Stripped length of the insulation 8.5 - 9.5 mm
_ Spring terminal for stranded wire with end splice or solid conductor

#### Spring terminal for stranded wire with end splice or solid conductor

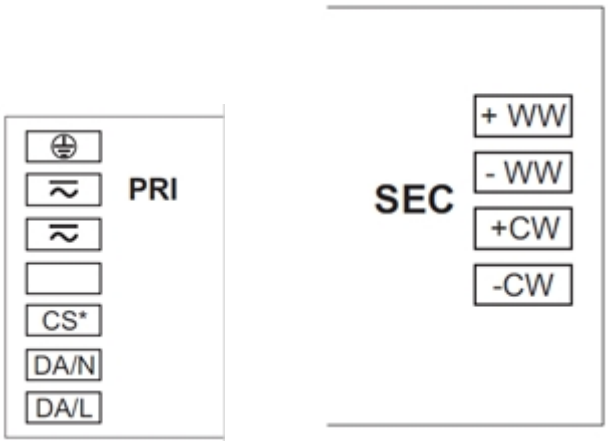
Permissible line cross-sections and stripped lengths of LED control gear with screw terminals can be found in the respective data sheets of LED control gear.



## 5.4. Connections on the LED Driver



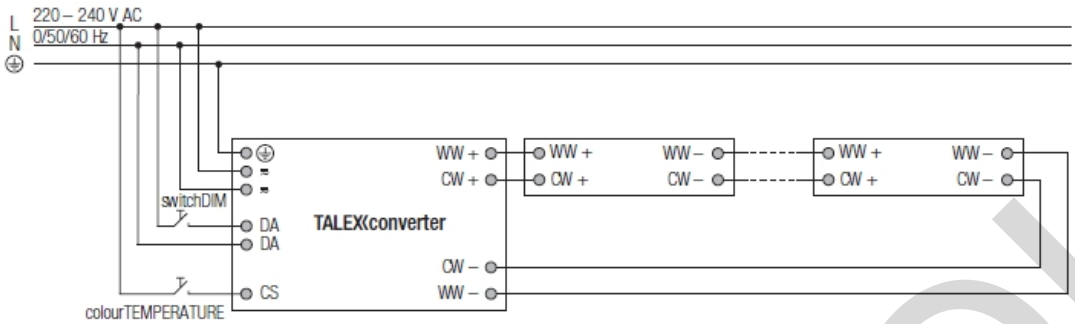

### 5.4.1. Connections on the LED control gear for LLE PRE Module

| Pin/Connection | Connection on the LED Driver | Design |
|---|---|---|
| ⏚ | Protective earth or functional earth | Spring terminal |
| ~ | Power input | Spring terminal |
| ~ | Power input | Spring terminal |
| DA* | Control input DALI / DSI / switchDIM / corridor FUNCTION | Spring terminal |
| DA* | Control input DALI / DSI / switchDIM / corridor FUNCTION | Spring terminal |
| CS | colourTEMPERATURE | Spring terminal |
| WW+ | LLE PRE Module - warmwhite PLUS | Spring terminal |
| WW- | LLE PRE Module -warmwhite MINUS | Spring terminal |
| CW+ | LLE PRE Module - coldwhite PLUS | Spring terminal |
| CW- | LLE PRE Module - coldwhite MINUS | Spring terminal |

* only with LED Driver with the corresponding functionality

## 5.5. Wiring diagrams

### 5.5.1. Wiring diagram for switchDIM and colourTEMPERATURE for LLE PRE KIT

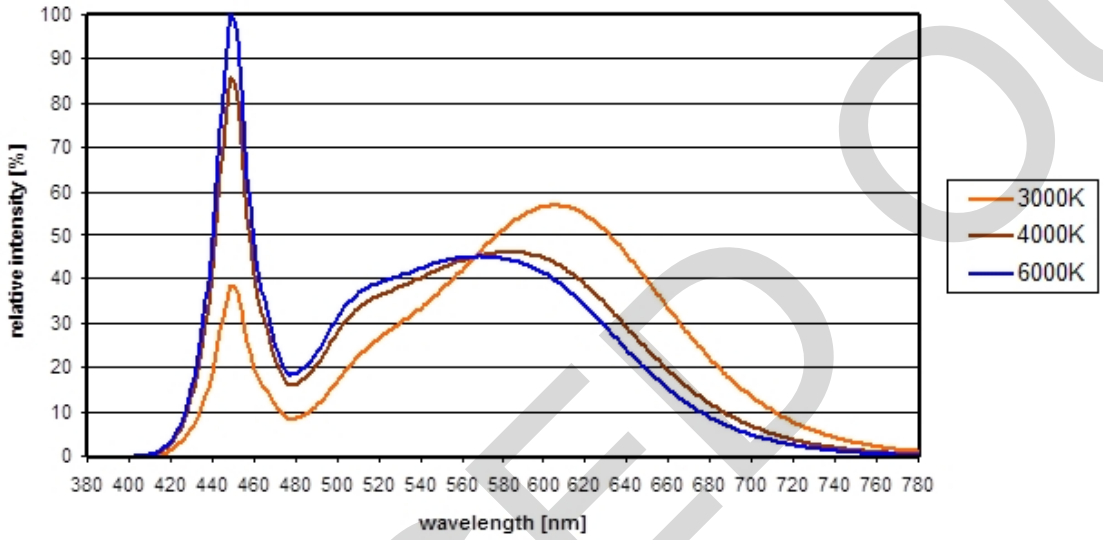



The wiring diagram shows the connection between an LED Driver and three up to five LLE PRE KIT modules and the connection between the LED Driver and the power supply.
The integrated switchDIM and colourTEMPERATURE functions are operated via appropriate momentary-action switches.

# 6. Optical Aspects

## 6.1. Colour spectrum

The used technology 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.

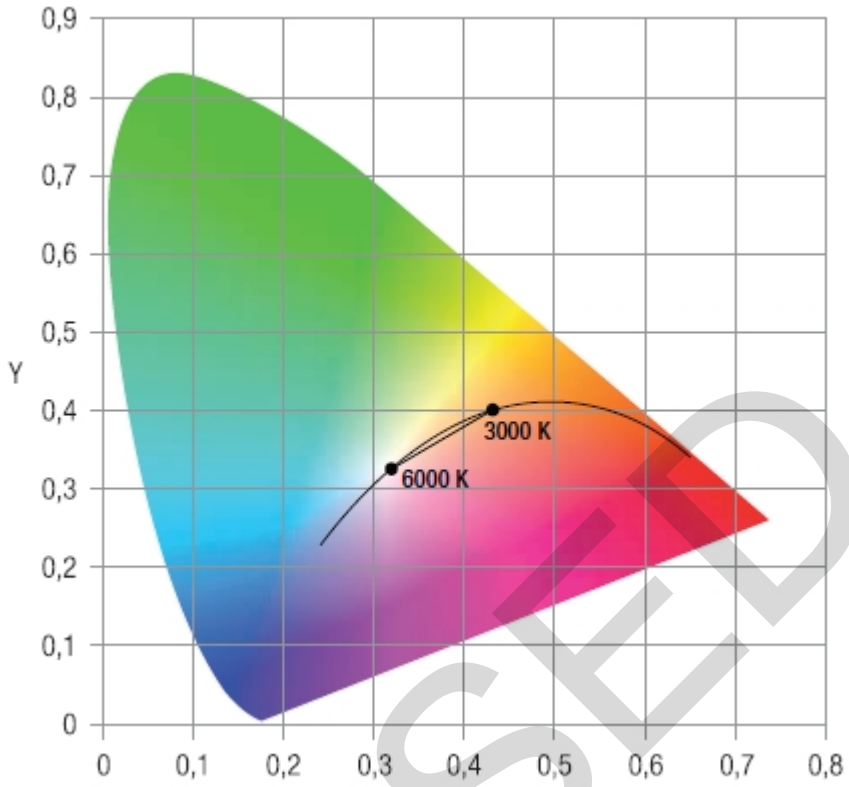



### Colour spectrum at different colour temperatures

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

### 6.1.1. Coordinates and tolerances (to CIE 1931)

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:**

| Parameter | Value |
|---|---|
| Ambient temperature of the measurement | $t_a$ = 25 °C |
| Measurement tolerances of the colour coordinates | ±0,01 |

## 6.2. Coordinates and tolerances

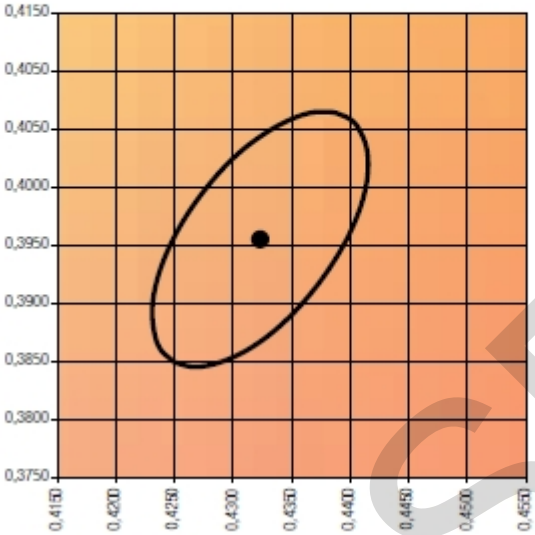
### 6.2.1. Light colours

LLE PRE KIT covers all the light colours below.

#### MacAdam Ellipse: 3,000 K

| 3.000 K | x0 | y0 |
|---|---|---|
| Mittelpunkt | 0,4325 | 0,3955 |

MacAdam Ellipse: 4SDCM

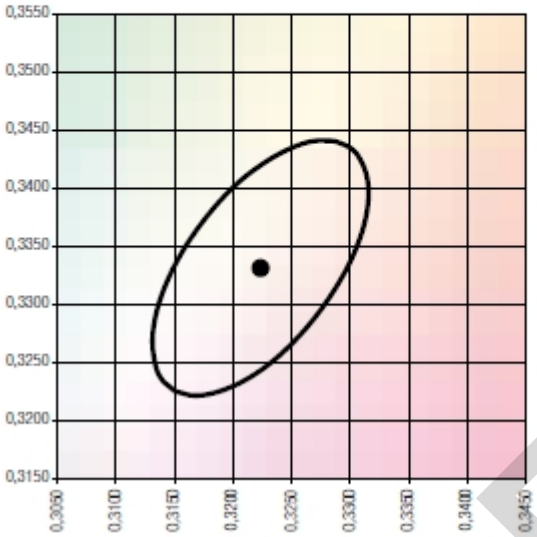


### MacAdam Ellipse: 6,000 K

**6.000 K**

| | x0 | y0 |
|---|---|---|
| Mittelpunkt | 0,3220 | 0,3330 |

MacAdam Ellipse: 4SDCM




## 6.3. 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.

# Optical Aspects

| 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.

## 6.4. 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 .

## 6.5. 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.

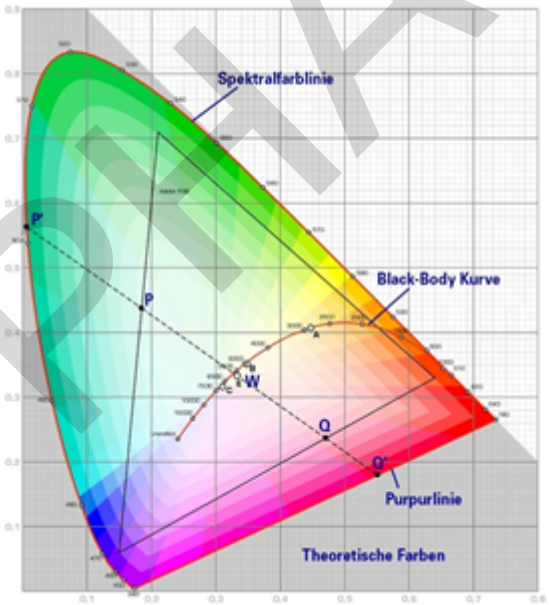
## 6.6. Secondary Optics

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.

## 6.7. 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.

### 6.7.1. 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.

### 6.7.2. 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).

### 6.7.3. Eye safety

| 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.

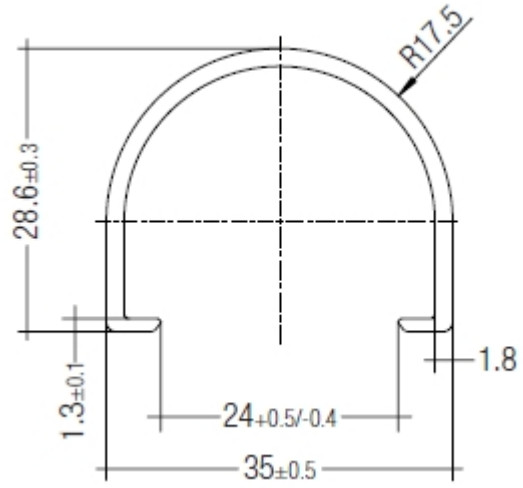
# Optical Aspects

_ High risk (risk group 3): The LEDs pose a risk even with just momentary or temporary exposure.

## 6.8. Beam characteristics

### 6.8.1. Reflector and diffusers

With LLE PRE modules, the luminaire can be produced with either a diffuser or reflectors. There must be a minimum distance of 3 mm between the active parts and the conductive optical parts, e.g., reflector to the LED module.

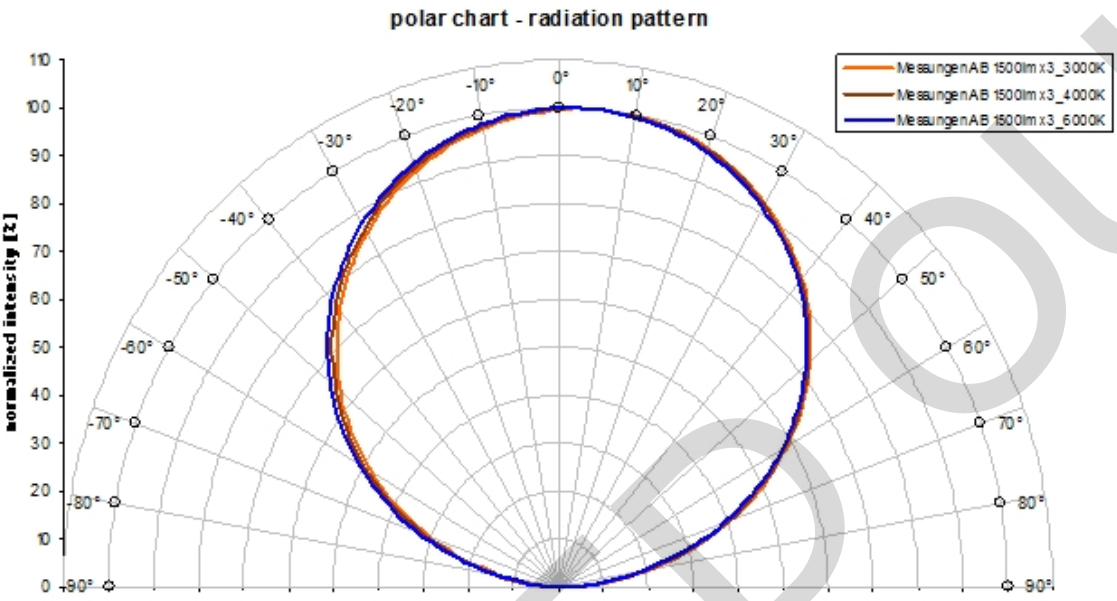



**⚠ CAUTION!**

When using reflectors in combination with a non-SELV LED Driver, protection against contact must be ensured. This is typically achieved with optics which cannot be removed over the module.

## 6.8.2. Beam characteristics of the LLE PRE module

### Maximum relative light intensity Iv/v



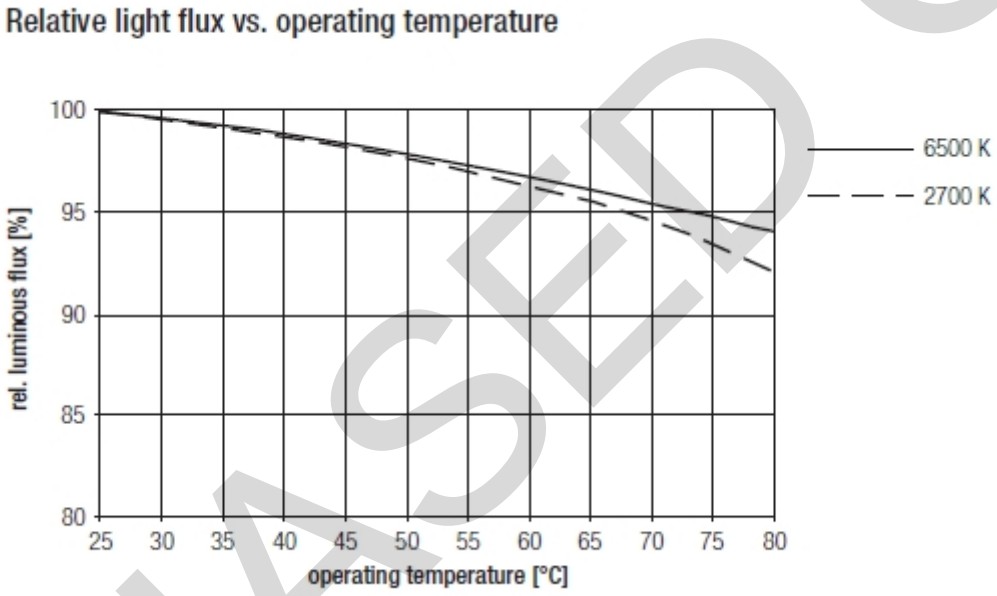
# 7. Thermal aspects

## 7.1. Module cooling

### 7.1.1. Effect of cooling on the life of the modules

The modules of the LLE PRE KIT system have been designed for operation with a passive heat sink and can be mounted directly on such a suitable heat sink.

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.




### Lifetime characteristic

The diagram shows the change in luminous flux in percent over an operating time

### Lumen maintenance for LLE PRE module

| tp temperature | L90 / B10 | L90 / B50 | L80 / B10 | L80 / B50 | L70 / B10 | L70 / B50 |
|---|---|---|---|---|---|---|
| 55 °C | 50,000 h | 50,000 h | 50,000 h | 50,000 h | 50,000 h | 50,000 h |
| 60 °C | 32,000 h | 50,000 h | 50,000 h | 50,000 h | 50,000 h | 50,000 h |
| 65 °C | 25,000 h | 50,000 h | 50,000 h | 50,000 h | 50,000 h | 50,000 h |
| 70 °C | 18,000 h | 40,000 h | 32,000 h | 50,000 h | 50,000 h | 50,000 h |

**NOTICE**

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

### 7.1.2. Requirements for the 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.

## 7.2. Passive cooling

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

### 7.2.1. Effect of cooling on the life of the modules

The modules of the LLE PRE KIT system have been designed for operation with a passive heat sink and can be mounted directly on such a suitable heat sink.
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.

**NOTICE**

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

**NOTICE**

Please keep in mind that LLE PRE KIT doesn´t support possibility to use active fans.

### 7.2.2. Requirements for the heat sink

The modules must not be operated without a heat sink. The heat sinks must be dimensioned to provide adequate cooling capacity.
The necessary $R_{th}$ value is decisive when selecting a suitable heat sink. This value depends on the thermal power loss of the module and the ambient temperature at which the module is to be operated. The $R_{th}$ value of the heat sink must always be smaller than the required $R_{th}$ value.

| Ambient temperature ($t_a$) | $R_{th, hs-a}$ LLE | Cooling surface LLE |
|---|---|---|
| 25 °C | 3.4 K/W | 100 $cm^2$ |

# Thermal Aspects

| | | |
|---|---|---|
| 35 °C | 3.0 K/W | 120 $cm^2$ |
| 45 °C | 2.3 K/W | 250 $cm^2$ |
| 55 °C | 1.5 K/W | 680 $cm^2$ |

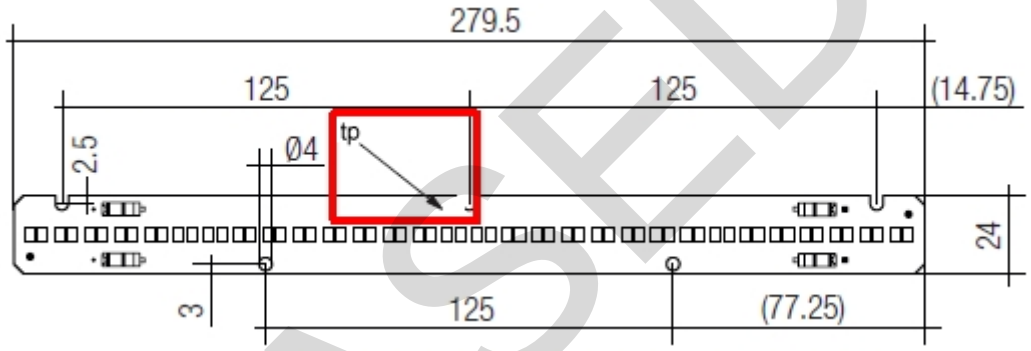
All the values refer to a maximum surface temperature $t_c$ = 65 °C and 350 mA.

The actual cooling surface can deviate depending on the material, design, external influences and the installation situation.

A thermal connection between LLE PRE Module and the heat sink using heat-conducting paste or heat-conducting adhesive foil is essential.

## 7.2.3. Temperature measurement on the module

### $t_c$point LLE




There is a $t_p$ point on top of the module for checking the temperature of the latter:
The temperature at the $t_p$ point can be measured with a simple temperature probe. Since the underside of the modules is made from anodised aluminium, any measurements taken with an infra-red camera would lead to inaccurate results.

In practice, thermocouples (e.g. B&B Thermotechnik, K-type thermocouple) have proved successful. Such thermocouples can be attached directly to the $t_p$ 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, 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.

The measurement must be taken in a steady thermal state and in a draughtfree room.

### 7.2.4. Temperature management of the LED Driver

Although the LED Driver have an integrated temperature management system, the requirements relating to cooling of the LED Driver must also be taken into account. Unintentional automatic dimming at overtemperature, for example, indicates inadequate cooling of the LED Driver.
The LED Driver temperature can be measured with a simple temperature probe at the $t_c$ point. The $t_c$ point of 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".
Sources for suitable heat-conducting foil and pastes for thermal connection to a temperature probe are given at the end of this documents.

# 8. Ordering information and sources

## 8.1. Article numbers

### 8.1.1. LLE PRE Kit CRI > 80 (calibrated kit)

| Type | Colour-temperature (K) | Typ. luminous flux[1)] (lm) | CRI | Typ. power draw[1)] (W) | System efficacy (lm/W) | Order No. |
|---|---|---|---|---|---|---|
| **STARK LLE 3x24-280-700-830-860 -PRE-KIT (1 LED Driver + 3 LED Modules)** | 3,000-6,000 Tunable White | 2,000 | > 80 | 20 | up to 90 | 89601896 |
| **STARK LLE 4x24-280-700-830-860 -PRE-KIT (1 LED Driver + 4 LED Moduls)** | 3,000-6,000 Tunable White | 2,650 | > 80 | 26 | up to 92 | 89601897 |
| **STARK LLE 5x24-280-700-830-860 -PRE-KIT (1 LED Driver + 5 LED Modules)** | 3,000-6,000 Tunable White | 3,350 | > 80 | 32 | up to 95 | 89601898 |
| **STARK LLE 3x24-280-1500-830-860 -PRE-KIT (1 LED Driver + 3 LED Modules)** | 3,000-6,000 Tunable White | 4,300 | > 80 | 40 | up to 101 | 89601899 |
| **STARK LLE 4x24-280-1500-830-860 -PRE-KIT (1 LED Driver + 4 LED Modules)** | 3,000-6,000 Tunable White | 5,700 | > 80 | 52 | up to 103 | 89601900 |
| **STARK LLE 5x24-280-1500-830-860 -PRE-KIT (1 LED Driver + 5 LED Modules)** | 3,000-6,000 Tunable White | 7,150 | > 80 | 63 | up to 106 | 89601901 |

All of the above LLE PRE kits meet MacAdam (SDCM 3) and have a uniform size of 280 x 24 mm.

# Ordering information and sources

[1] Tolerance range for optical data: ±5 % and tolerance range for electrical data: ±15 %.

### 8.1.2. LLE PRE Kit CRI > 90 (calibrated kit)

| Type | Colour-temperature (K) | Typ. luminous flux[1] (lm) | CRI | Typ. power draw[1] (W) | System efficacy (lm/W) | Order No. |
|---|---|---|---|---|---|---|
| **LLE 24x280mm 3x700lm 930-960 PRE KIT (1 LED Driver + 3 LED Modules)** | 3,000-6,000 Tunable White | 2,000 | > 90 | 20 | up to 100 | 89602734 |
| **LLE 24x280mm 4x700lm 930-960 PRE KIT (1 LED Driver + 4 LED Modules)** | 3,000-6,000 Tunable White | 2,650 | > 90 | 26 | up to 102 | 89602735 |
| **LLE 24x280mm 5x700lm 930-960 PRE KIT (1 LED Driver + 5 LED Modules)** | 3,000-6,000 Tunable White | 3,350 | > 90 | 32 | up to 105 | 89602736 |
| **LLE 24x280mm 3x1500lm 930-960 PRE KIT (1 LED Driver + 3 LED Modules)** | 3,000-6,000 Tunable White | 4,020 | > 90 | 40 | up to 98 | 89602737 |
| **LLE 24x280mm 4x1500lm 930-960 PRE KIT (1 LED Driver + 4 LED Modules)** | 3,000-6,000 Tunable White | 5,360 | > 90 | 52 | up to 101 | 89602738 |
| **LLE 24x280mm 5x1500lm 930-960 PRE KIT (1 LED Driver + 5 LED Modules)** | 3,000-6,000 Tunable White | 6,700 | > 90 | 63 | up to 104 | 89602739 |



All of the above LLE PRE kits meet MacAdam (SDCM 3) and have a uniform size of 280 x 24 mm.

[1] Tolerance range for optical data: ±5 % and tolerance range for electrical data: ±15 %.

# Ordering information and sources

### 8.1.3. 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 LLE PRE KIT.

| Product name | Article No. |
|---|---|
| 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.

## 8.2. Partners

### 8.2.1. 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

# Ordering information and sources

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

### 8.2.2. 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

### 8.2.3. 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

### 8.2.4. 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

### 8.2.5. Tridonic sales organisation

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

### 8.2.6. Additional information

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

# Ordering information and sources

Further information and ordering data:

_ LED 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