

From design to product

# LED-Modules and -Systems

passion.experience.reliability.

## **Our competence - your advantage**

Advanced know how by experience

Everyone is unique and so are our customers. Every customer has his own ideas and needs, which are particularly important to him. To meet these requirements, it is our ambition to find target-oriented and custom-fit solutions.

Precise analysis and planning are the basis for high-quality lighting concepts. During the systematic planning of your lighting project, we support you with concrete decision-making aids for efficient solutions that meet your requirements.

Our experts from the LED Competence Center ensure short development times. The optimum interaction of all components achieves the ideal result for your system. Through the close cooperation between you and our project team, we can promise a fast implementation of your LED system. We can cover special needs, such as colour tunable concepts or sensor technology for intelligent lighting control.

Your advantage: High-quality products that are optimally designed by us for maximum efficiency and long lifetime. For light that even exceeds your requirements.

The latest LEDs straight from the development laboratories of well known LED manufacturers are tested in our own photometry laboratory by our engineers. This enables us to evaluate the progress of LED technology at an early stage, to participate actively in the designs of new products and thus to be a pioneer in LED technology development. Your layouts are individually developed by our experts. You receive customized solutions from one source.

We offer you highest quality and engineering „Made in Germany“.

Let us break new ground together and realize your application with highest quality, reliability and in compliance with the latest standards. As an innovative and family-owned company we are prepared for future challenges – especially in the lighting industry.

Your satisfaction is our highest goal.

## passion.experience.reliability.

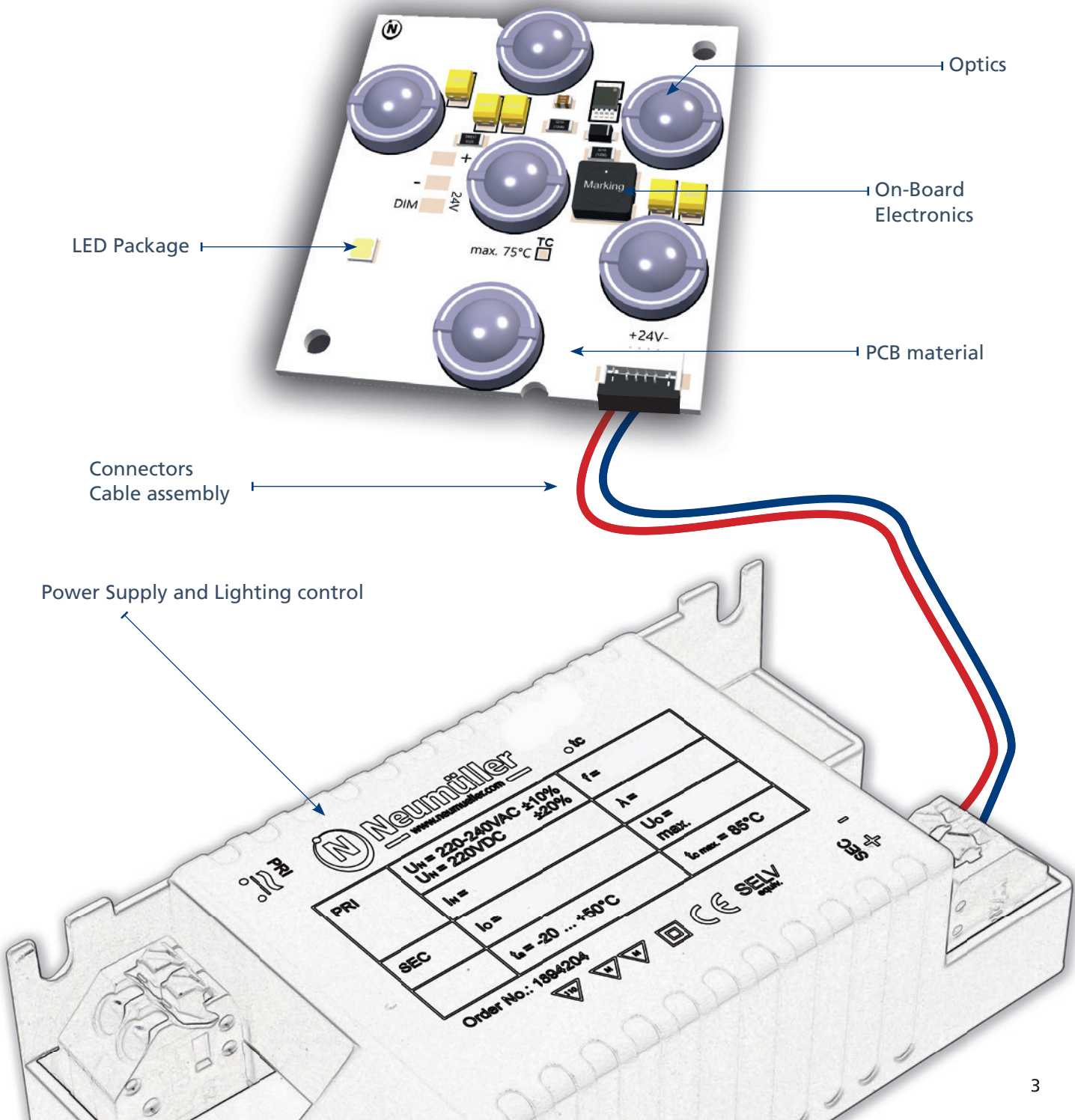
are the central focus of our work. We react to your requirements with passion and solution-oriented action; our many years of experience offer you objectivity and competence to procure or develop optimized products for your application; we demand reliability not only from our products but also from ourselves.

## Custimized LED solutions

### Adapted to your requirements

During the analysis of needs, you and our experts determine your individual system solution according to your requirements. This can be based on desired parameters such as light colour, light yield and light distribution.

On the following pages you can see for yourself the strengths and possibilities of our team of experts, which is at your disposal. Together we will find the perfect solution according to your requirements.

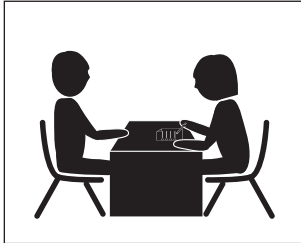




# Planning and implementation of your LED system

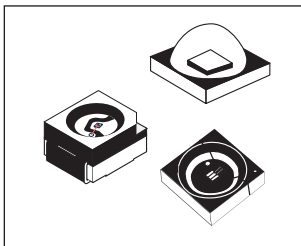
## from analysis of specification to product

The progress from your product idea to series production is often a complex and costly process. Therefore, each individual step has to be coordinated safely, seamlessly and fluently, just like a gear box. Our proven process chain includes all steps of product development. By adjustments and optimizations we ensure that your product is and remains state-of-the-art according to your wishes.



### Analysis of specification

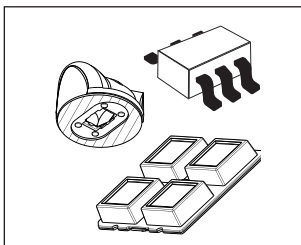
In a joint discussion with our experts, you determine your requirements for your LED module. In addition to luminous flux, light colour, power, light control and light direction, the desired dimensions and a feasible cost framework are also specified in our checklist.



### LED-selection

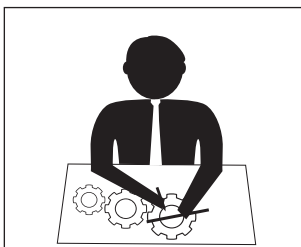
Using this checklist, our experts in the LED Competence Center will choose the right light-emitting element from our wide range of products for you.

The main parameters are luminous flux, quality of color (CRI) and color temperature. Special customized selections of these values could be offered by us.



### System components

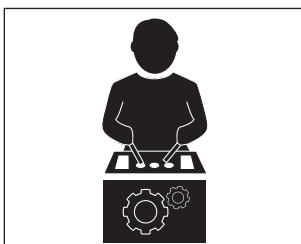
After the successful selection of your desired LED, in cooperation with you we determine all further components for your system. For optimal thermal management, the suitable PCB material is selected according to your design (FR4, aluminium, flex, copper). In addition, our checklist also includes the selection of the appropriate connection of the modules. Our options range from simple solder pads and connectors to tailor-made cable assembly.



### Layout and concept development

Based on the specified data of our checklist and the desired components, we calculate the cost of your product. You will receive a detailed offer including a concept drawing from us free of charge.

Our services, including the preparation of the offer, are a service from us and therefore not connected with any costs for you.

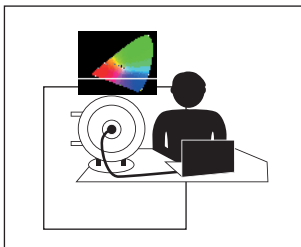


### Production of Prototypes

We start the production for your close-to-production samples. These will be manufactured in the same production plant that will later supply your series production. In this way we ensure that sample and mass products have exactly the same level of quality.

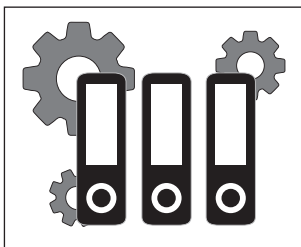
For urgent projects, as an intermediate step, „rapid prototyping“ with in-house manual assembly and reflow soldering equipment is possible for urgent projects.

The dimensions here are limited to 300mm x 300mm.



## Check the parameters

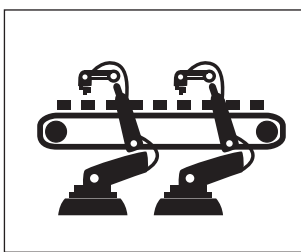
Once the samples have been produced, they are tested in our laboratory for compliance of all the parameters you have specified. Based on the test results, our experts prepare a detailed data sheet so that all parameters for series production are precisely defined. You will receive the samples for your own testing purposes.



## Preparation for production

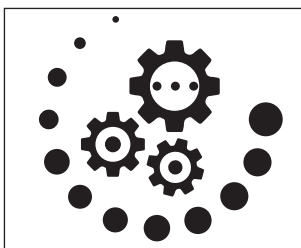
After your sample approval and the placement of a series order, we create the final production documents including BOM (bill of material), production instructions and packaging specifications. We take care of the procurement of all necessary components for mass production. Commonly used connectors, standard components, LED drivers and reverse polarity protection diodes are usually kept in stock by us, which enable us to shorten production time and lead time.

Should you need help with the certification of your LED module, we will be happy to assist you. On request, we can handle the certification process for you on request.



## Mass production

The production takes place at our selected partners in Germany, Europe or Asia. As we know the focus and strength of each production facility, we can determine the optimal production location. The selection of the production site is made by our experts already before sample production.

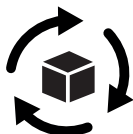


## Subsequent processing

Should you have any requests outside your LED solution, such as special rails, brackets, reflector plates, drilling templates or similar, we will be happy to assist you with our manufacturing partner.



## We do not neglect the ecological aspect either.



### Reusable packaging

Goods from German and European production are delivered in environmentally friendly reusable pendulum packaging.



### Short transport routes

With production facilities in Germany and Europe, we ensure short transport routes and thus less CO<sub>2</sub> pollution during transport



### Long Lifetime

The proven long lifetime of our LED modules also contributes to the conservation of resources and the environment.

# Analysis of specification

Directly with you on site

You determine the requirements of the LED module in your application on site with one of our experts. Our colleagues are well trained in the LED business with many years of experience. Working personally and professionally with you, to find the best way to specify your product

You can define the parameters with us step by step with our detailed checklist. Our experts are at your side with professional competence to find with you the best possible solution for your product.

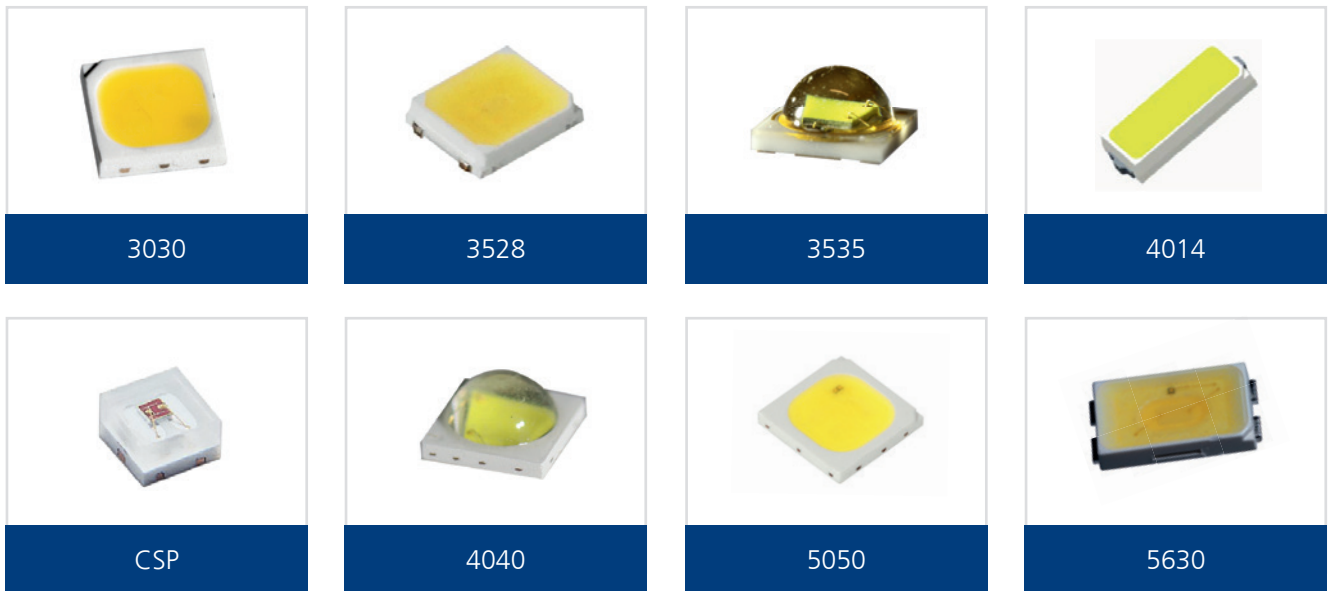
In addition to luminous flux, color temperature, power, light control and light direction, the required dimensions of the module will be discussed with you. Furthermore, the cost framework defined by you is part of the checklist. The checklist is the base for the design of your concept and offer. Through the exact documentation of all parameters, requirements and wishes it is possible to design a solution that meets your demands on the LED module. This method has proven itself based on our experience and ensures that every specification is recorded by you.



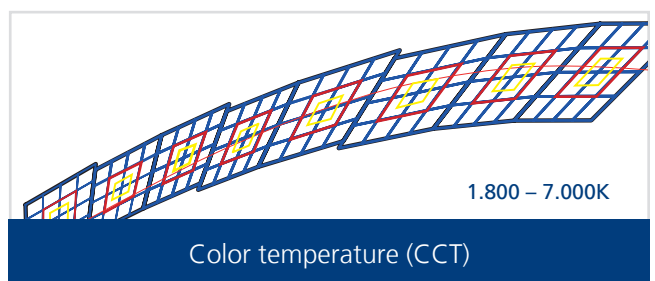
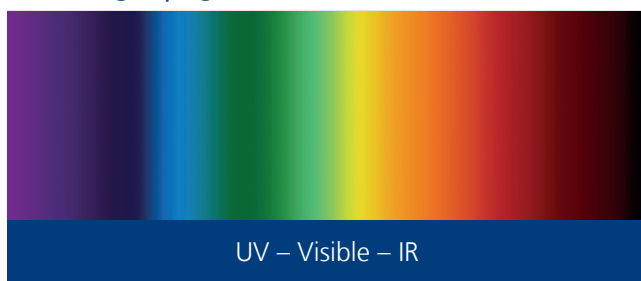
## LED selection

Diverse possibilities for module creation

We offer a wide range of LED packages and power classes. A close and cooperative partnership with leading LED manufacturers enables us to offer the ideal LED for you. We can arrange special bin selections better than the standard selection offered by the manufacturer. Please find below the most common LED designs.



### Wavelength | Light color





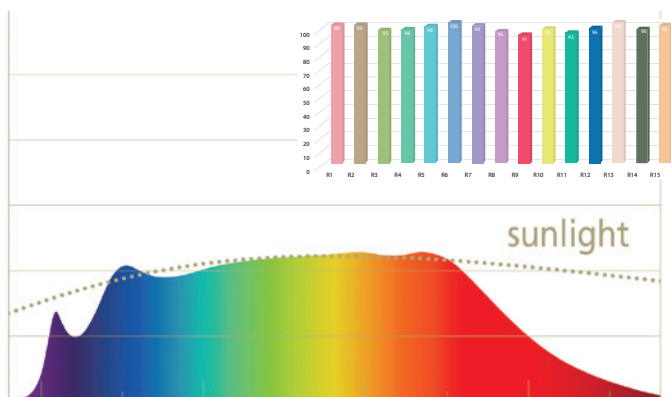
## Special LEDs

Full spectrum | Horticulture

We offer LEDs with optimized light spectra for very special applications like sun simulation in the office or for use in the plant sector.

### Full spectrum LEDs | for human well-being

- ✓ **2.700K – 6.500K**
- ✓ **CRI 95<sup>+</sup>**
- ✓ **CQS 95<sup>+</sup>**
- ✓ **TM30 (Rf96-98 | Rg99-102)**

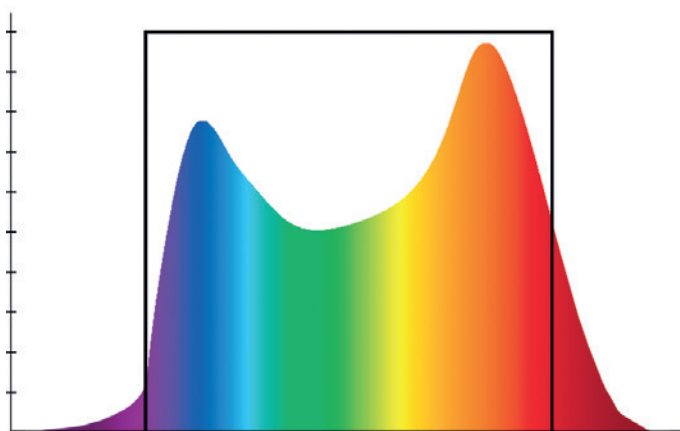


Similar to the sunlight spectrum, the peak in the blue region is lowered in full-spectrum LEDs. As a result, the light is less stressful for the eyes, stable circadian rhythms in humans are maintained and the color clarity of objects is improved.

The possible applications of full-spectrum LEDs range from HCL applications and plant lighting to medical and cosmetic applications – not least because of their excellent color fidelity and high contrast.

### Horticulture | LED-Technology for Plant Growth

- ✓ **spec. Wavelength**
  - » 450nm
  - » 660nm
  - » 730nm
- ✓ **PPF up to 2,2  $\mu\text{mol/s}$**
- ✓ **110° – 125°**



Thanks to a wavelength range adapted to the specific needs of plants, flexible control and low energy consumption and heat generation, LED lights for plants offer numerous advantages. The lighting can be individually adapted to any type of fruit, vegetable or flower.

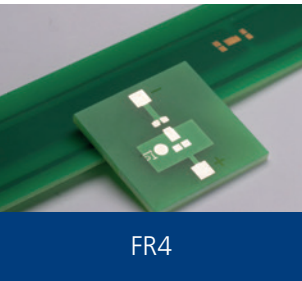
By using special secondary optics for light guiding, a all around illumination of the plants could be realized. So the plants do not consume energy to align themselves with the sun and grow faster.

# Selection of further system components

## Completion of the application

The right PCB material serves for optimal thermal management. Further more we will assist you by choosing the other components including the power supply for your applicaton. Suitable contacting and light control are a key factor for desining the perfect LED module. A small choice of our possibilities is shown in the following pictures.

### Material



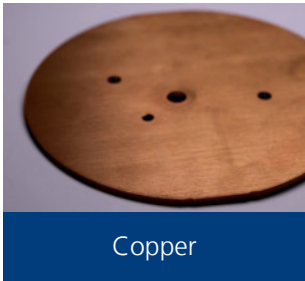
FR4



IMS



FCP



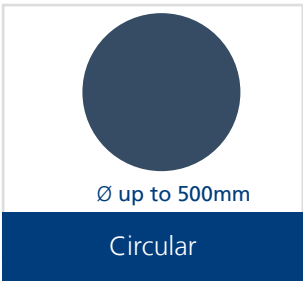
Copper

### Shapes



Width: from 4mm  
Length: up to 1.500mm

Stripes



Ø up to 500mm

Circular



Square – Octagon

Polygon



various forms  
are feasible

Free form

### Optics | reflectors



3° | 160°  
symmetrical | asym-  
metrical

single lens



Arrays:  
3-lens up to 160-lens

Lens arrays



up to 1.140mm

Stripes



Reflectors

### Power Supply



Constant current (CC)



Constant Voltage (CV)



230V Direct operation



Driver IC's

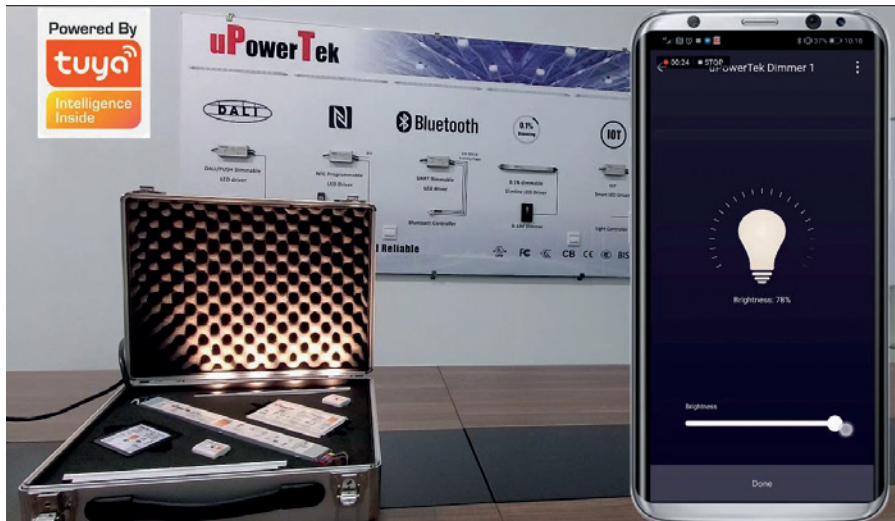




## Intelligent LED-Driver

Easy control of LED applications

Whether one or more LED power supplies in the mesh network: We have the right Bluetooth controller for your application. Thanks to the user-friendly interface, the LED power supplies can be set individually or in groups quickly and easily. Scenes or automated sequences can not only be created as desired, but also continuously expanded.



### Light control

**PUSH-DIM**

Push-DIM

**1-10V**

1-10V

**DMX**

DMX

**DALI**

DALI

### further Components



Connectors



on-Board-Electronic



Cable assembly



Potting

## Layout and concept design

visual appearance is only one point

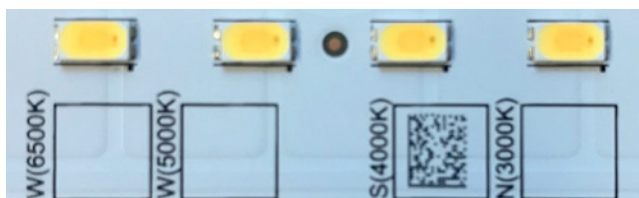
Once the components have been selected, we start the design of your module.

To include all your requirements, our layout and design experts put with their experience and knowledge the finishing touches to your module.

Special attention is taken to adapt the thermal design optimally to the requirements. Furthermore, we make sure that the arrangement of plugs and drill holes is sensibly designed to ensure smooth assembly in the final application.

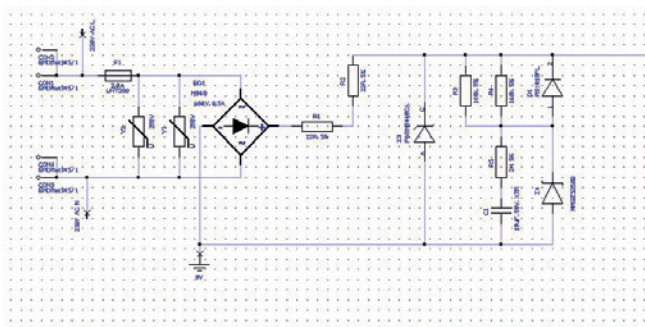
On request, your customer logo or product code can be imprinted on the printed circuit board. We have marking concepts for the PCBs for different light colours, e.g. with QR codes.

Furthermore our CAD software can provide a 3D model of the LED module as well as drawings in DXF format. This facilitates the approval process for your luminaire.

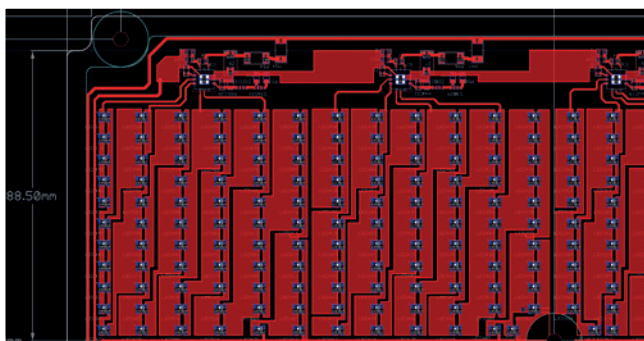
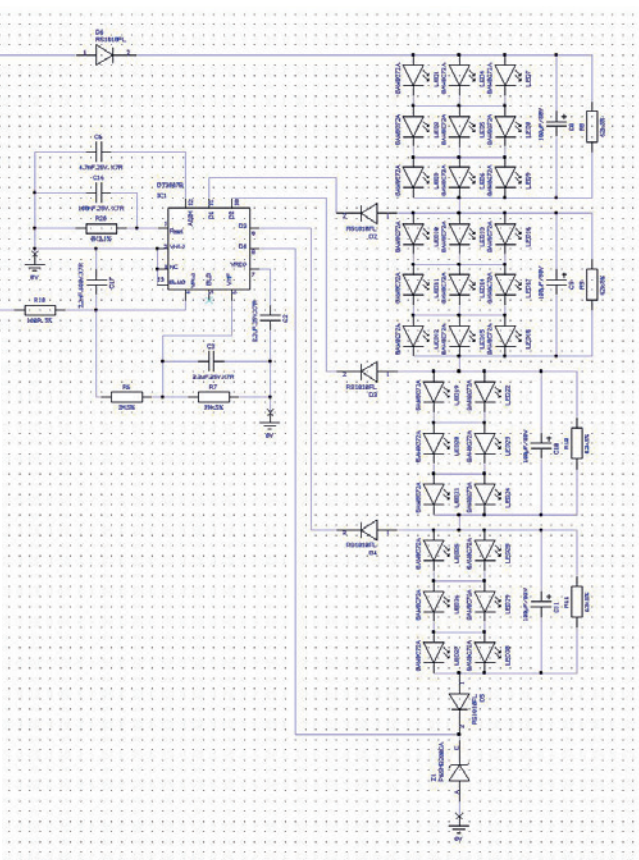


Clear identification of the LED module by means of QR code

## Up to this point our service is free for you.



Development of the electronic circuit for the realization of the desired functions



Implementation in the circuit board design

## Production of prototypes

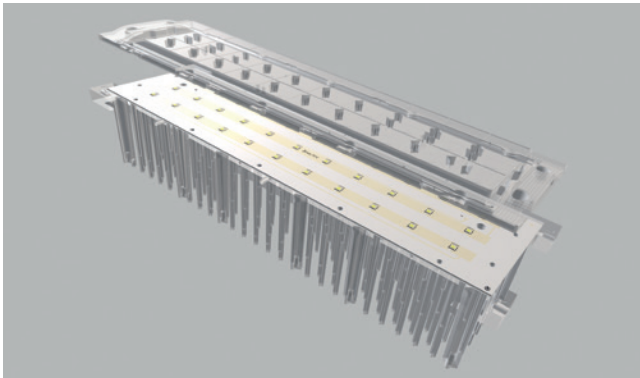
Now samples close to series production are produced

The samples are manufactured in the production plant that will later supply the series, that ensures that sample and series products have exactly the same quality.

As an intermediate step for urgent projects, rapid prototyping with in-house manual assembly and reflow soldering is possible.

The dimensions here are limited to 300mm x 300mm.

All electrical, mechanical and photometric parameters will be tested. Besides these parameters, it is checked whether the planned secondary optics fit 100% and whether the Ic for current setting is correctly adjusted. The testresults of the prototypes are compared with the values in the specification, if necessary the parameters are adjusted before the samples are sent to the customer.



3D model of the LED module



Finished LED module including optics



### Certifications/Guidelines

#### DIN EN62031

The standard specifies general and safety requirements for LED modules. Its applicable for LED modules without integrated control gear for operation at constant voltage, constant current or constant power; LED modules with integrated control gear for use with DC power supplies up to 250V and AC power supplies up to 1,000V at 50Hz or 60Hz.

#### ENEC

The ENEC mark indicates that the product meets relevant EN safety standards and performance testing requirements. That the manufacturer works with a quality system according to ISO 9001. It includes, that the end products are re-tested annually and the manufacturer has a documented production control, e.g. through production inspections.

#### CE Marking

CE marking demonstrates compliance with EU legislation. It is to be applied by the manufacturer or his/her representative. By applying the CE marking a manufacturer declares – on his/her sole responsibility - that the product meets all the legal requirements and can thus be placed on the EEA market.

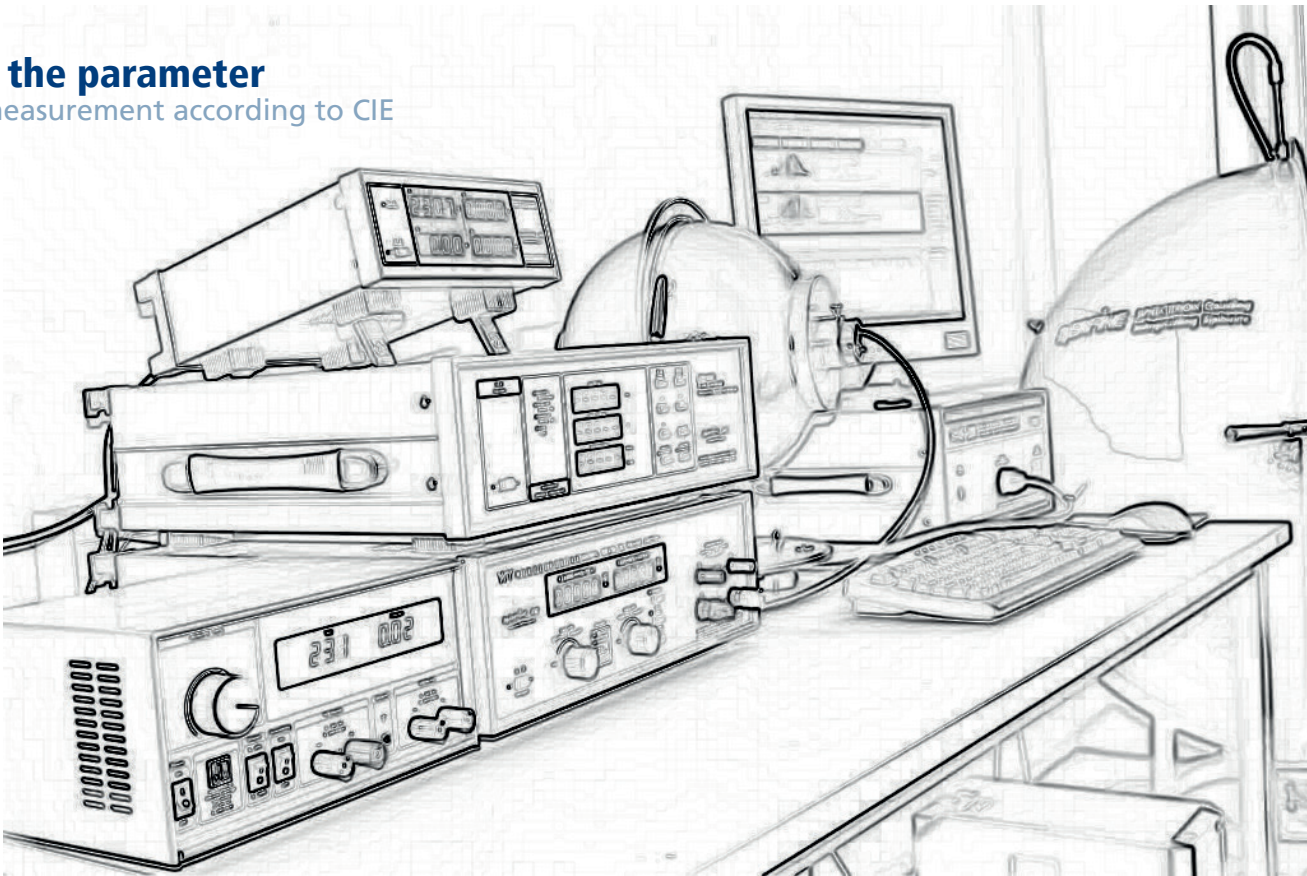
#### UL

UL stands for Underwriters Laboratories Inc. and is one of the world's leading organizations for testing and certification in the field of product safety. It tests and certifies a wide variety of materials, components and end products for their operational safety, particularly with regard to possible personal injury and the development of fires.



## Check the parameter

Light measurement according to CIE



## Photometric measurements

### Measurements with integrating sphere

total luminous flux, colour temperature (CCT), spectrum, colour coordinates, CRI, TM30, dominant Peak and medium wavelengths, electrical parameters (U, I), power and efficiency.

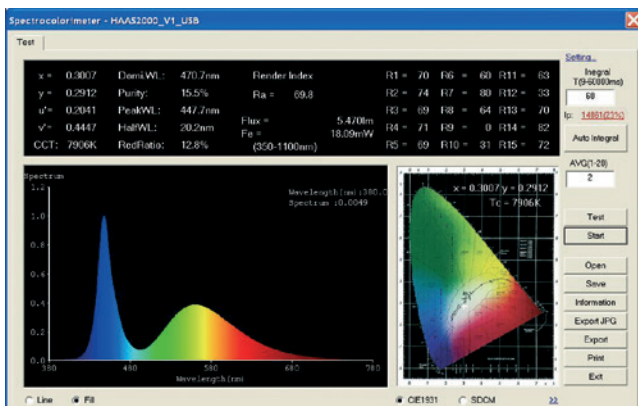
### Measurements with goniophotometer

Luminous intensity distribution curve, full width at half maximum, total electrical power.

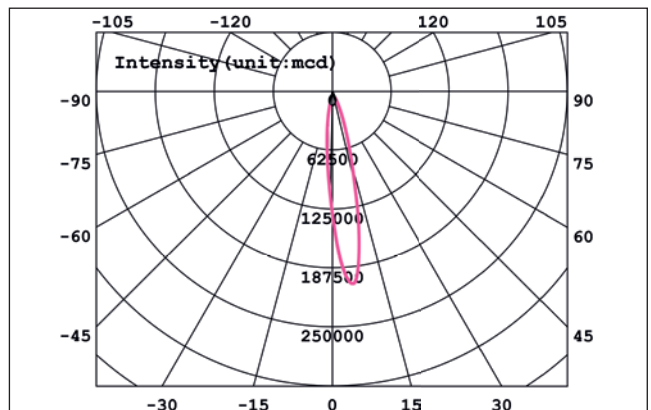
### Photometric analysis

Luminous flux and electrical power, analyse of the total loss of each component.

## Display of the charts



Spectral light distribution



Radiation pattern of an LED with optics



## Our equipment

Light measurement according to CIE

### Spectroradiometer



- CCD Array 1024 x 128
- Wavelengths Measuring range: 395 – 1.100nm (UV | visible | IR)
- Test parameter: 9ms - 60s
- Measure variables: :  
Color location (x, y/u, v) | Color temp., CRI; Ra, Ri ;i= 1 - 14, spectral light distribution P(λ), luminous flux, light output

### Integrating sphere Ø30cm | Ø100cm



- Measurement of the total luminous flux in lm according to the requirements of CIE 127

### Goniophotometer



- Radiation characteristics of LEDs and optics
  - » angular resolution 0.1
  - » luminous intensity 10mcd - 200cd

### UV-Messungen



- Spektralbereich 200-1100nm
- Spektralsoftware für Farbmessung, radiometrische und wirkungsbezogene Messungen
- Transmissionsmessung

## Measurement and evaluation parameters

Measurement and evaluation possibilities from UV (350nm), over visible, to IR (1.100nm)

### Luminous flux (lm)

Measured in lumen (lm), determines the brightness of a light source in a 3-dimensioned room.

### Luminous intensity (cd)

Luminous flux/steradian angle, measured in a candela (cd), indicates how bright a light source illuminates in a certain direction.

### Photosynthetic photon flux (PPF)

PPF or photosynthetic photon flux is the amount of photons-being created by the light which falls within the spectrum which plants can use for photosynthesis..

### Illumination (lx)

Luminous flux/Area, measured in LUX (lx) determines how bright an area is illuminated.

### Chromaticity coordinate

x, y coordinates determine the position of the color temperature in the CIE -XYZ color space

### CRI | TM30

Color rendering index describing the quality of color reproduction of light sources of the same correlated color temperature.

### Colour temperature (CCT)

Measured in Kelvin, gives the color impression of the light from cold white to warm white.

### Wavelength (nm)

visible light has a wavelength between 380 to 780nm. With our equipment we can measure from UV 360nm and up to IR of 1100 nm. Our measuring range also includes the UV range from 350nm and extends into the IR range up to 1,100nm.

### Beam angle (°)

In degrees, describes the light emitting angle of a light source, usually defining the emission angle as FWHM

### Beam type

Is the directional release of the light of a luminaire

### Spectrum

Weighted distribution of light over the wavelength range of the total electromagnetic radiation.



## Preparation for production

After sample release and the order for massproduction

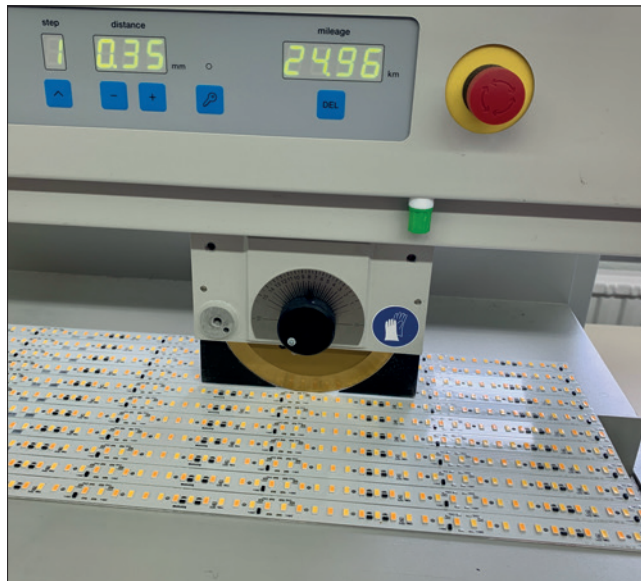
Preparation for production includes instructions to the manufacturing partner, such as the circuit board material to be used, the colour of the solder resist and the screenprint, as well as all other defined data such as function test, putting the label according to the drawing, packaging and labelling LED stripes boxes with label (Art. No. , quantity, Binnig) and other defined data.

Furthermore, we ensure that all necessary components for the planned LED module are in stock in sufficient quantity or are ordered and delivered in time, so that no delay occurs.

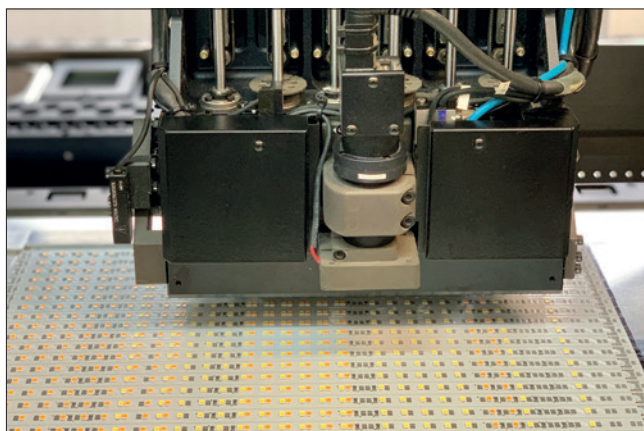
## Massproduction

Germany | Europe | Asia

Depending on quantity, price and delivery time, the modules are produced by selected partners in Germany, Europe or Asia. Each manufacturer has its own areas of focus, which we know exactly and can therefore determine the optimal production location. We are also happy to take about your wishes into account here, such as „Made in Germany“.



Production line





# Subsequent processing

Special solutions in plastics technology



Individual optics for a custom LED module

We can offer to you additional solutions in plastic technology with our partner

From prototypes and special solutions to massproduction of accessories for the lighting industry, we can realize customized solutions. These could be for example: housing or housing inserts, optics and reflector plates, fitting piece, drilling jig wages.

For this purpose various materials such as plastics, wood, stainless steel, composite plates etc. can be used for this purpose. Any kind of processing can be realized. Drawing files, e.g. files in DXF format, can be transferred directly.

We develop and design according to your specifications.

General key data	
working area:	15,600 x 3,000 mm
stroke:	200 mm
accuracy:	0.01 mm



Handrail elements

## Project example

Lighting installation pedestrian bridge Harsefeld



Installation by Kofahl LED-Lichttechnik, Woltersdorf



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