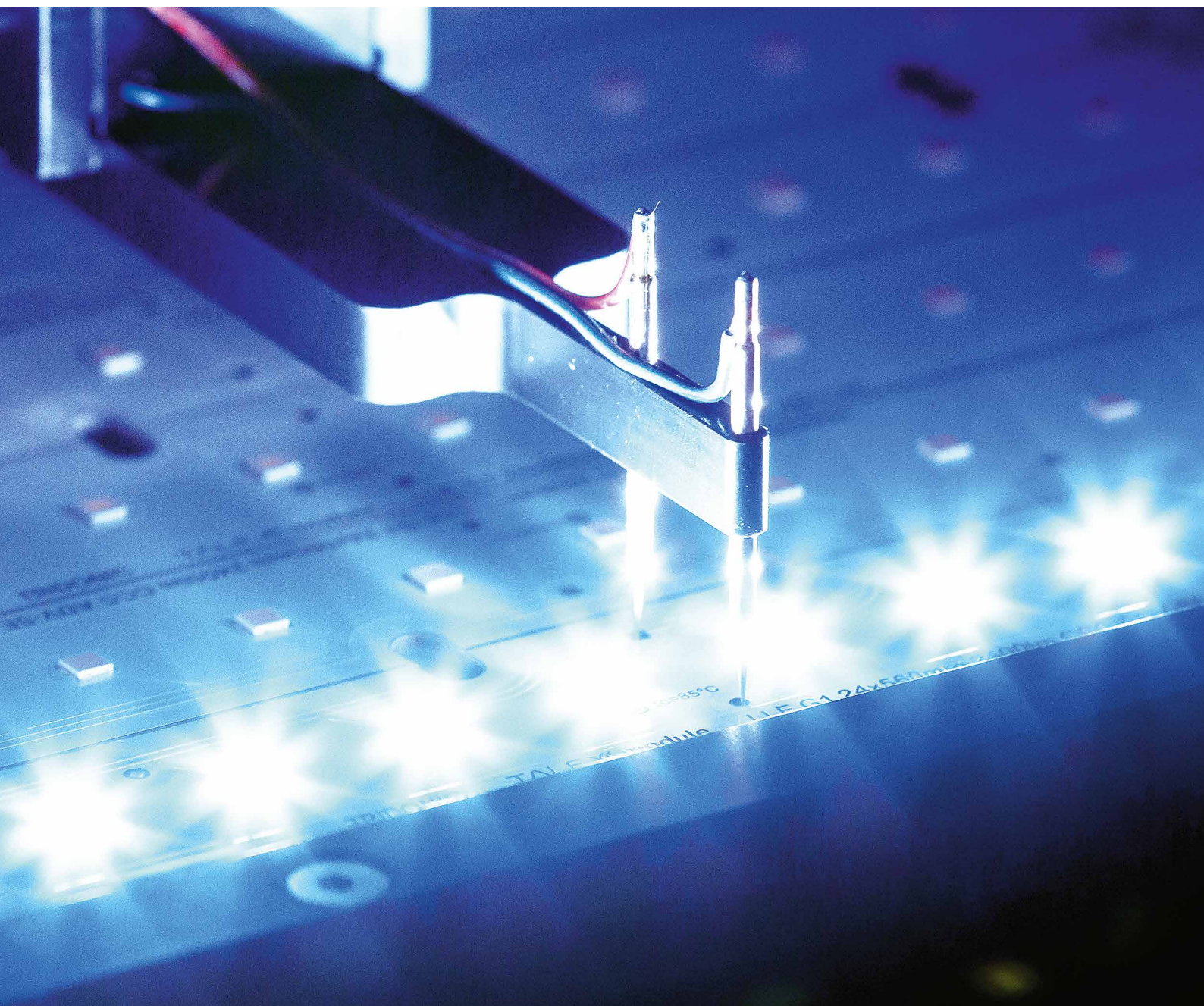


Technology+

The countless facets of perfection

LED modules



TRIDONIC



“LEDs and progress go firmly hand in hand. But yesterday’s new developments are considered run of the mill today. That is why Tridonic uses its innovative capabilities to open up a whole new world of reliability that not only meets but regularly exceeds the expectations of its many and varied customers.”

Martin Werkovits

Head of R&D Competence Center Light Sources, Tridonic Jennersdorf GmbH

Areas of expertise – an overview

LED modules

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1 Long-standing expertise

- Experience of having delivered over 100 million LED modules
- Ongoing optimisation from one generation of modules to another makes for technology that is always state of the art

Page 7

2 High-quality raw materials

- All raw materials conform to the Tridonic standard
- Our suppliers are all technological leaders in their respective sectors
- Intensive market analysis through benchmarking processes

Page 8

3 Strict qualification programme

- Extensive testing of all relevant materials
- Zero-tolerance demand for the highest standards
- Advanced tests on relevant material combinations

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4 State-of-the-art production methods

- Very high level of automation
- Clean room production in line with the highest European standards

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5 Universal product diversity

- Four high-performance ranges to cater for all customer needs
- Zhaga-compliant product designs

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6 Final tests well above average

- 100% test quota
- Exceptionally stringent testing according to criteria for processing capacity, optical characteristics and reliability

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7 Complete solutions from a single source

- Perfectly coordinated modules, drivers, sensors and control units
- Best performance of any light engine

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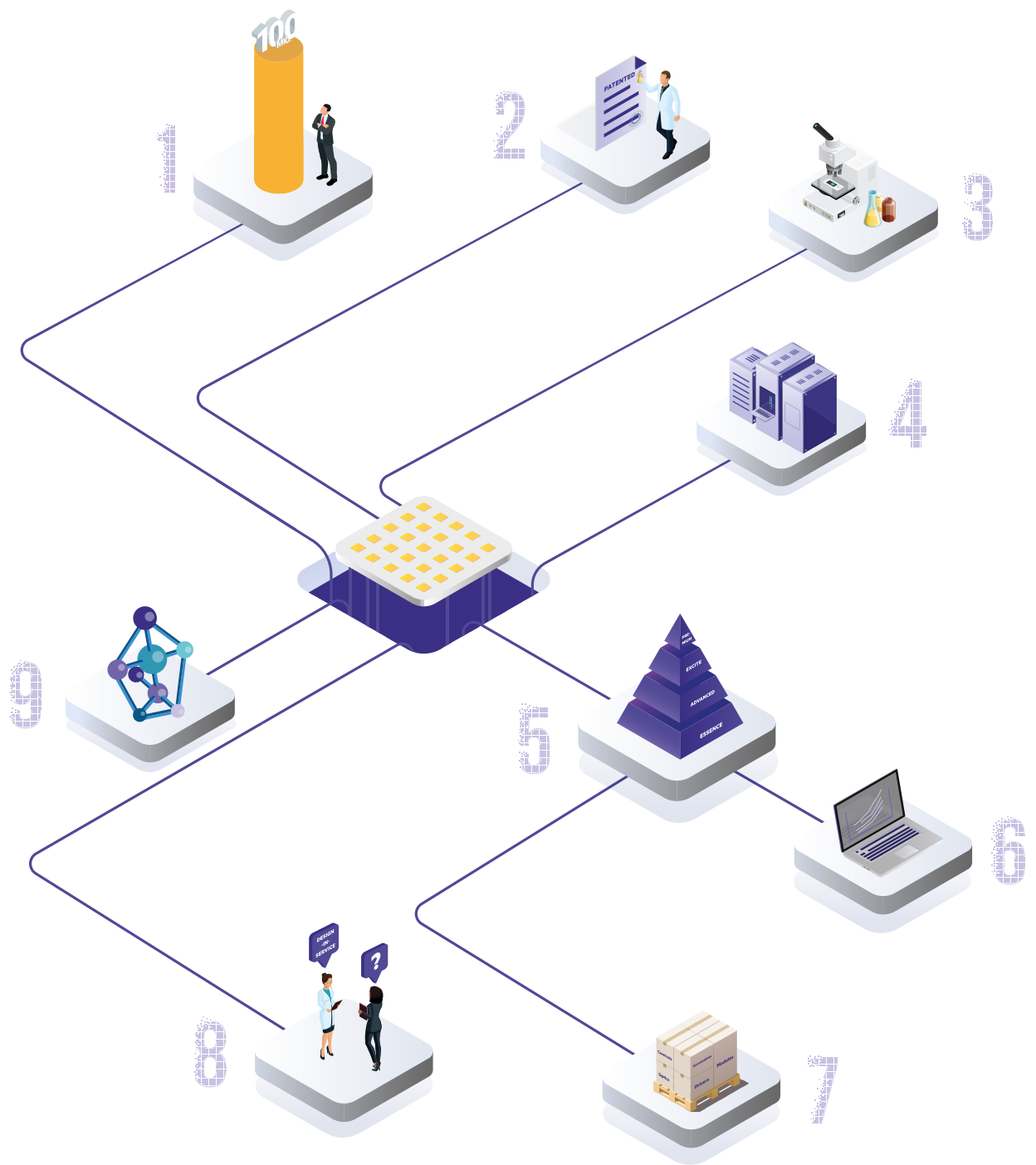
8 Customer support

- Design-in service
- Comprehensive Tridonic data sheet
- Certification support

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9 Commitment to science and involvement in industrial associations

- Helping to shape new norms and international standards
- Innovative technologies developed in close collaboration with leading research institutes

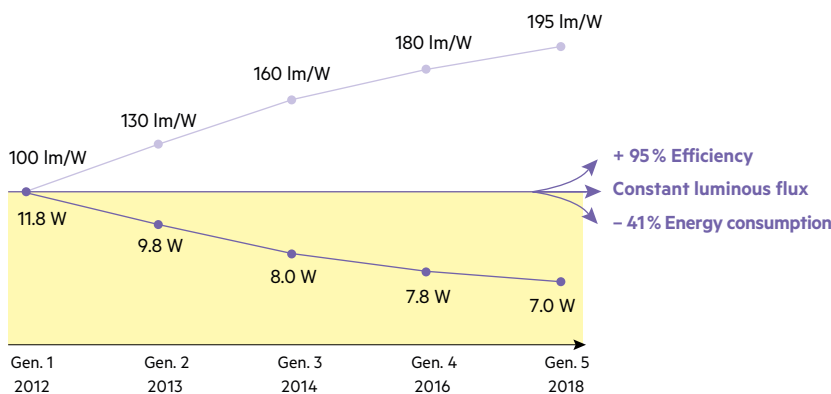


Long-standing expertise

Since the year 2000, more than 100 million LED modules have left the European production site. This is an impressive statistic showing both expertise and experience. As a result, Tridonic has managed to establish itself as a trailblazer in the development of LED components. The company now has 1,600 employees and 74 locations all across the globe.

The experts at Tridonic are constantly pushing the boundaries of LED technology. Module series such as the SLE – now in its 7th generation and subject to consistent improvement – are the perfect proof. To date, Tridonic has patented more than 2,700 innovations.

Increase in SMD module performance



Each new generation of module is the fruit of rigorous further development work. Particular attention is paid to delivering constant improvements in efficiency so that less power is consumed without any reduction in luminous flux. To make switching over to the new module generation as simple and profitable as possible, each one offers an efficiency enhancement of at least 10%.

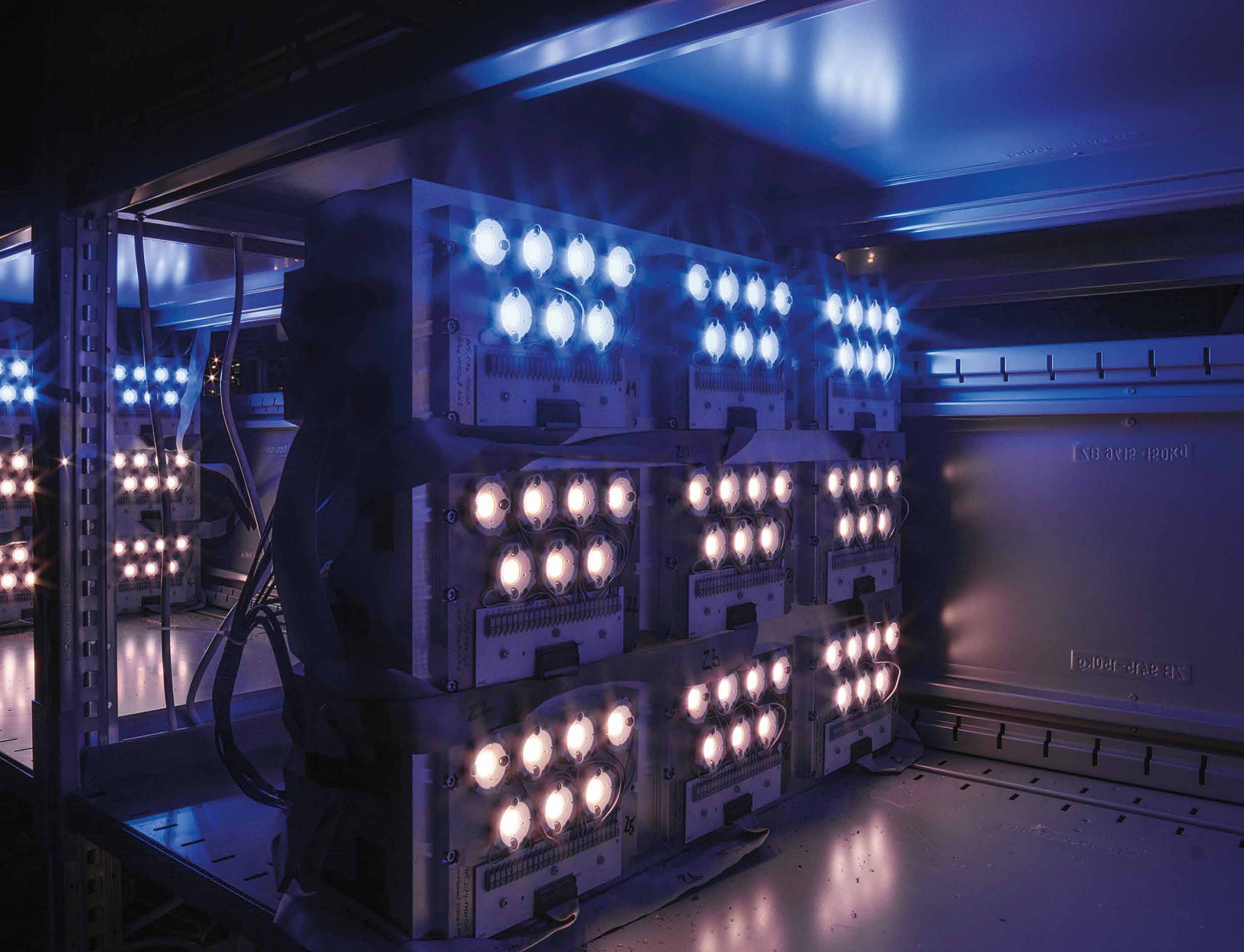
Superb colour rendering

The tough Tridonic qualification programme ensures that Tridonic LED modules achieve optimum colour consistency (CRI and SDCM values). For evaluating the colour rendering and colorimetric locus, Tridonic also uses the latest alternatives to CRI, such as TM-30-15.

Special colours

Whether displaying food, fashion or works of art, the special colour SLE modules from Tridonic offer complete freedom meaning the perfect impression can be created with all sorts of objects.





2 High-quality raw materials

Right from the start, Tridonic insists on top quality to ensure outstanding technology of the highest level. All our raw materials (IP-free SMD LEDs, substrates, adhesives, phosphors, silicones, etc.) are sourced from carefully selected partners who have been identified via benchmarking. The reliability of each component is verified by carrying out a series of tests in accordance with the JEDEC standard. Depending on the result, the component is classified for various application areas.

A trailblazer in lighting technology

More than 40 licensees have put their faith in Tridonic's patents. As a member of the B.O.S.E. consortium, Tridonic co-owns a range of patents for orthosilicates (special phosphors), which are capable of generating stunning white light in conjunction with blue LEDs.



Strict qualification programme



Tridonic's qualification tests easily exceed the requirements of any standard. All materials (such as substrates, adhesives, terminals and – of course – the LED packages) undergo additional qualification processes. Before the LED chips are turned into finished modules, they are tested and ranked on the basis of three categories:

Optical characteristics

To stop the performance deviating from that stated on the data sheet, Tridonic only accepts LEDs with golden sample verification. To determine the optoelectronic characteristics of the LEDs, their colour shift behaviour is tested at various current levels and operating temperatures (-40°C to +120°C).

Processing capacity

At Tridonic, quality assurance is not only performed on the finished products themselves, but as early as preliminary development. This ensures delivery capacity as well as production free of defects.

Reliability

In order to assess the LEDs in terms of their robustness, colour stability and mechanical stability, Tridonic relies – among other things – on a much higher number of cycles than usual across a vast array of testing methods.

| Description | Verification of reliability | Test duration |
|---|--|---|
| Optoelectronic parameters (colour stability) | HTOL 90 °C – nominal luminous flux | 1,000 h |
| | RTOL 25 °C – nominal luminous flux | 1,000 h (6,000 h) |
| | RTOL 25 °C – maximum luminous flux | 1,000 h (6,000 h) |
| | 85/85 min. power input | 1,000 h |
| | 85/85 nominal luminous flux | 1,000 h |
| | 60/90 min. power input | 1,000 h |
| | 60/90 nominal luminous flux | 1,000 h |
| Mechanical stability | Temperature cycle -40/85 FR4 and IM S | 1,000 cycles |
| | Room temperature cycle / SST | 25,000 cycles (up to 100,000 cycles) |

Optional: LTOL -40 °C, temperature cycle -40/125, H2S test

Operating cycle tests

The robustness of the entire SMD package is verified, including, for example, the golden bond wires. By running 100,000 cycles, Tridonic easily exceeds the 25,000 cycles that are stipulated as standard. In addition, the thermal action is simulated (30 seconds on, 30 seconds off).

Ensuring perfect colour stability

The optoelectronic parameters are investigated at ambient temperatures of up to 85°C and humidity levels of up to 90%.

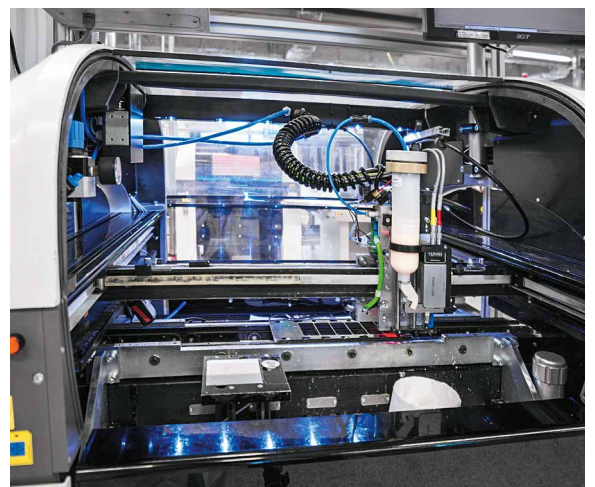
Temperature shock test

In the cooling and heating chamber, LED materials are alternately subjected to extreme temperatures from -25 to +105°C. In this way, the mechanical stability of constituents such as the bond wire or lead frame can be verified. This process is repeated more than 1,000 times.



4 State-of-the-art production methods

Without exception, Tridonic manufactures its products to the highest European specifications. Various factors play a key role in quality, ensuring that the products can be made available quickly and reliably. These factors include the clean room atmosphere, highly automated SMD and COB facilities, and the highest degree of production flexibility.



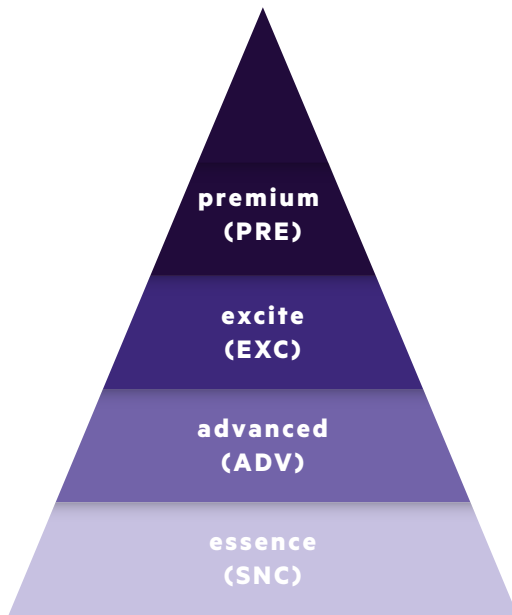
Patented production methods

Tridonic uses a variety of techniques to make sure the modules can be operated efficiently and reliably, such as its patented method for fixing the dies on the board.

5

Universal product diversity

Thanks to the vast array of products in its range, Tridonic offers ideal solutions for various luminaire types – from spotlights and downlights, linear and flat luminaires to circular luminaires. The modules have been designed to support all kinds of applications. They cater just as fully for industrial environments as they do for shops, offices and educational establishments or outdoor settings. On request, Tridonic can supply luminaires to specification and can develop products according to individual requirements and preferences.



Four product categories

Each of the four categories exhibits specific characteristics that are tailored to a whole host of lighting tasks.

premium (PRE): Modules for exacting demands and tasks, such as the Tunable White technology for customisable light.



excite (EXC): The solution for high-end lighting tasks – offering lighting scenes full of emotion, maximum flexibility and special colours.

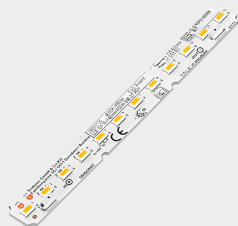
advanced (ADV): Combines high efficiency with outstanding quality of light.

essence (SNC): Focuses on the core functions to meet the specifications of particular applications.

Spotlights and downlights Modules: SLE and DLE



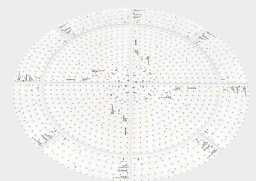
Linear luminaires and light strips Modules: LLE and LLE FLEX

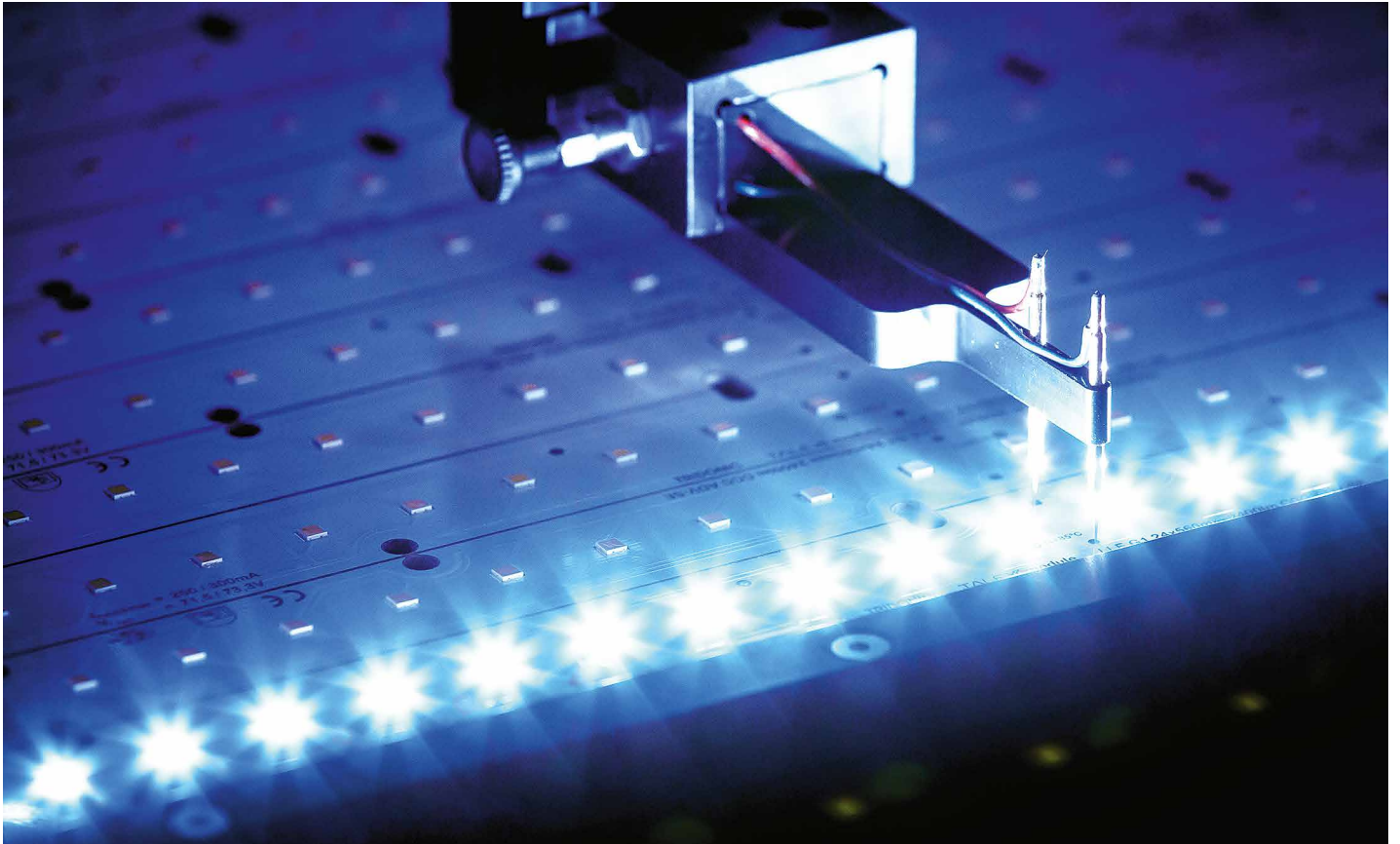


Area lighting Modules: QLE and RLE



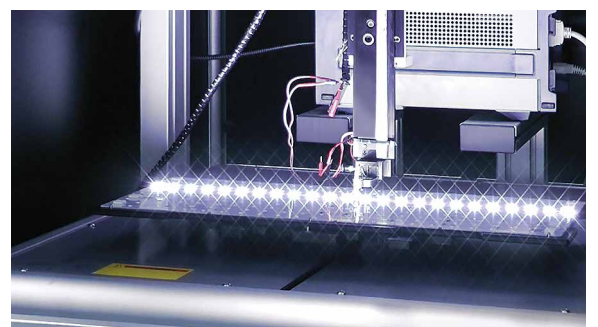
Circular wall and ceiling-mounted luminaires Modules: CLE





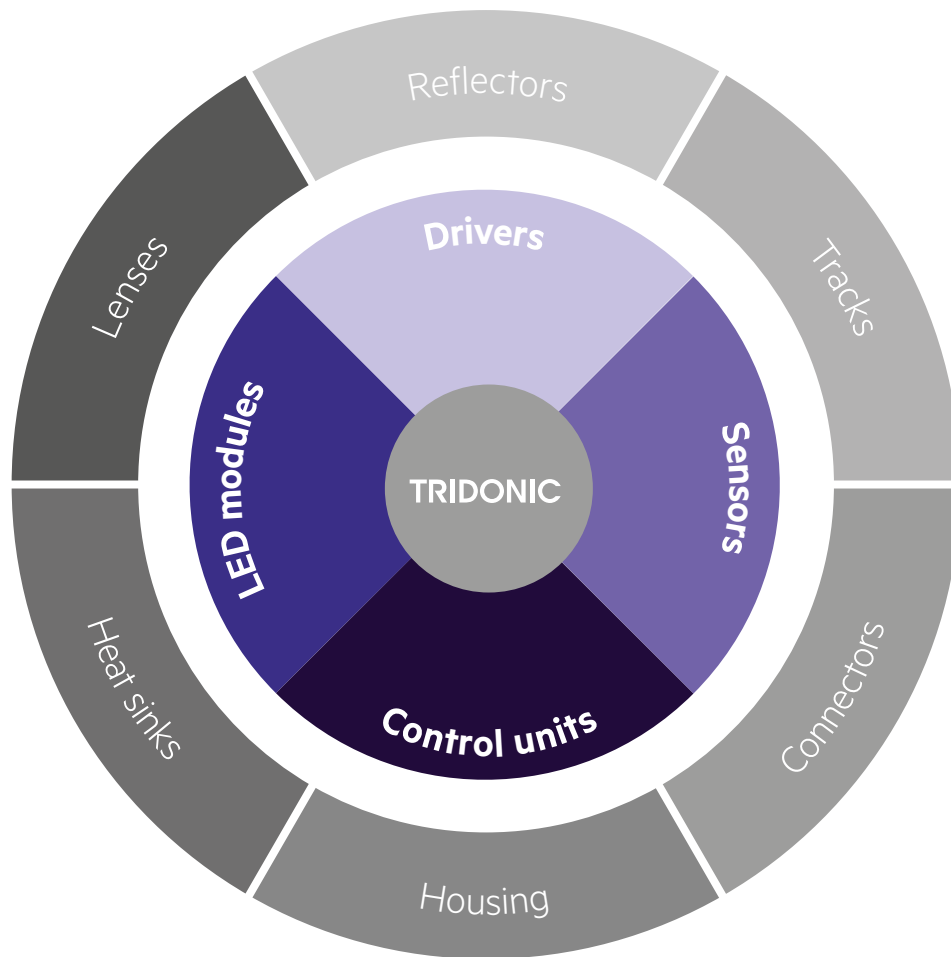
6 Final tests well above average

Before the LED modules leave the production site, they are subjected to a series of intensive final tests. This means, for example, that each Tridonic module meets the demanding tolerances of max. +/- 10% for the luminous flux and efficacy. In this way, Tridonic also ensures that the products adhere to the defined colorimetric locus and stringent colour tolerances.



100% test quota

Before proceeding with delivery to the customer, Tridonic checks each product at the factory for the following: luminous flux, electrical parameters, efficiency, colour temperature, CIE and MacAdam coordinates.

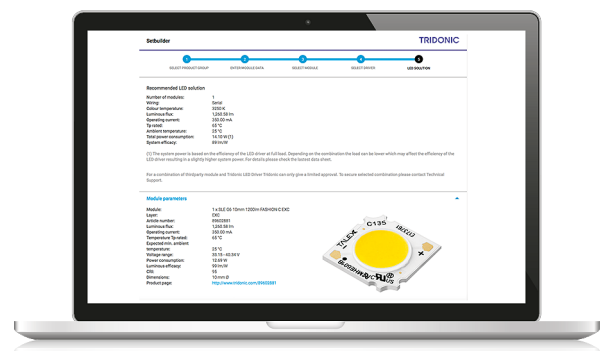


7

Complete solutions from a single source

Tridonic sees itself as a partner for luminaire manufacturers. For this reason, it offers comprehensive solutions rather than just individual components. All modules, drivers and control units are perfectly coordinated with one another to form an efficient unit. By adding optional accessories, these solutions can then be customised and adapted to meet specific needs.

Tridonic cultivates close partnerships with suppliers of heat sinks, reflectors, lenses and luminaire housings. These products complement the Tridonic range perfectly and reduce development costs and effort for manufacturers.



Tridonic Setbuilder: With this handy web tool, the ideal combination of LED module and driver can be found quickly and easily.



8

Customer support

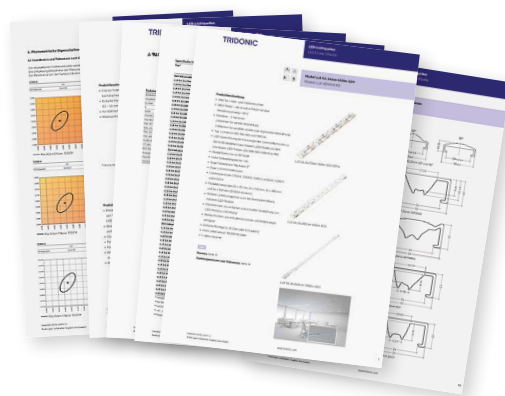
Direct contact

Local contacts are available at the branches to answer any technical queries.

Design-in service

Thanks to the design-in service, each component is able to master every technical challenge. What's more, the Tridonic test reports offer support during luminaire certification.

Video about the Tridonic design-in service:
www.youtube.com/tridonic



Comprehensive data

Tridonic provides its customers with the most detailed data sheets available on the market, making luminaire design a whole lot easier. In addition, it offers:

- LM 80 data
- RAY data
- Data on thermal behaviour
- Environmental compatibility statements
- CAD data

Commitment to science and involvement in industrial associations

Tridonic collaborates closely with national and international standardisation bodies. This keeps Tridonic constantly abreast of any changes and means that it is actively helping to shape the future of lighting technology. In turn, this saves luminaire manufacturers a great deal of work. Numerous research projects have already come about as a result of cooperation with research institutes, such as Joanneum Research and the Materials Center Leoben (MCL).

Certificates / Standards



**Tridonic products in use**

- Module LLE 24 mm 650 lm/ft ADV
- Driver DALI 150-400 mA Ip

Together, Tridonic and luminaire manufacturer Erventec have created something spectacular for the atrium at the company headquarters of dSPACE in Paderborn (Germany) – a tailor-made lighting solution that not only ensures optimum visibility but also accentuates the stunning architecture. Each of the elliptical galleries is crowned by a circle of light that runs all the way around. These circles of light comprise two different linear LED modules plus a set of dimmable LED drivers from Tridonic. The LED modules have been specially arranged to provide a functional combination of vertical and lateral light.

“The elliptical shape of the light strips was a real challenge. There was a lot more to it than simply meeting the criteria that had been set in terms of light engineering, function and aesthetics. Rather, it called for a high degree of design intelligence. With Tridonic, it was possible to succeed on both fronts.”

Andreas Ervens

Managing Director, Erventec GmbH & Co. KG, Lüdenscheid, Germany

Close light

We attach great importance to a strong international presence – this allows us to stay sufficiently close to our customers

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Light you want to follow.

