LED professional
BY LUGER RESEARCH

www.led-professional.com

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Review

LpR

The Global Information Hub for Lighting Technologies and Design

July/Aug 2023 | Issue 98

CREE LED

J Series® LEDs with Precison Dimming

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Cree LED introduces a fourth binning dimension, Precision Dimming, to enhance the industry standard 3-dimensional binning. OEMs will see consistent light output and hue variations with low-current dimming across LED strings – and have fewer bins to manage.

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- 80 & 90 CRI minimum available

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RELIABILITY.
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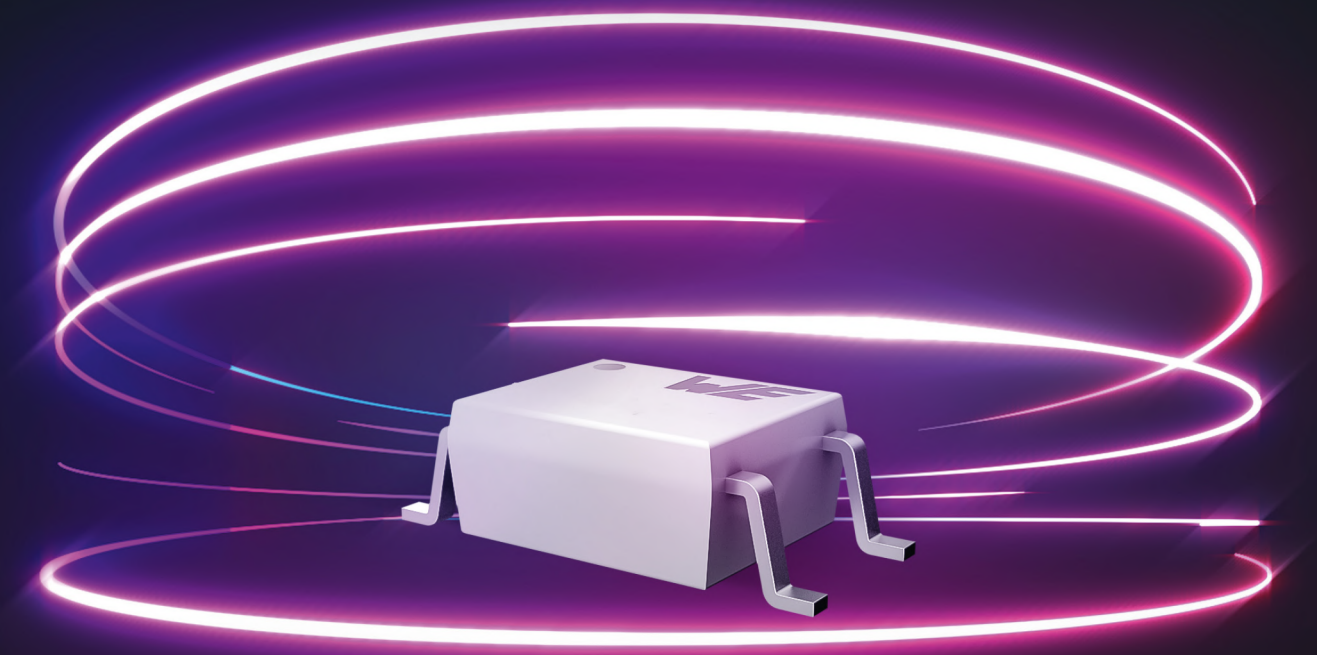
Optocouplers by Würth Elektronik



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Optocouplers by Würth Elektronik

With the new optocouplers, Würth Elektronik presents one of the latest additions to its optoelectronic product portfolio. The innovative design features a coplanar structure and high-grade silicon for total internal reflection. The coplanar design ensures the isolation gap stay fixed during the production process and provide perfect isolation and protection for your application. The total internal reflection provide stable CTR over the whole temperature range and high CTR even at low current operation.

Provided in all industry standard packages. Available with all binnings ex stock. Samples free of charge: **www.we-online.com/optocoupler**

#OptocouplersbyWE

Highlights

- Innovative coplanar design
- High grade silicon encapsulation
- Copper leadframe for high reliability
- Stable CTR over whole temperature range
- High CTR in low current operation

DIP-4 SOP-4 LSOP-4

Efficient Lighting – Illuminate Responsibly

Once more, I am pleased to present the latest LED professional Review (LpR), July/August 2023 issue, #98.

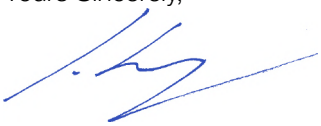
Nowadays, energy efficiency is resuming a more dominant role. It involves optimizing the efficiency of lighting systems to reduce energy consumption, lower electricity costs, and minimize environmental impact. Some critical aspects of energy efficiency in lighting are LED Lighting, Lighting Controls, Efficient Lighting Design, Labeling Programs, Maintenance and Inspection, Natural Light, Awareness & Education.

From August 25th, 2023, fluorescent T5 and T8 lamps will be banned from being placed on the European Union market. This significant transformation requires safe and efficient changeover concepts for new installations and retrofitting that comply with technical and legal regulations.

We cover various disciplines and applications in this issue and would like to introduce you to new technologies, design approaches, and innovations. Jan Denneman from the Good Light Group sensitizes us with ”good light.” We interviewed Mr. Kanetaka Sekiguchi, President and CEO of Citizen Electronics, about the company, the market and technologies and his successful KAIZEN strategy. We have also prepared the topic of Controls in four facets for you: Signify shows us Matter, an ideal smart home solution; RECOM introduces a new light controlling system for agriculture; the DALI Alliance leads achievements in sustainability with DALI control systems, and finally, Analog Devices shows which topologies are used efficiently for automotive drivers. Lastly, Lumitech/Kiteo presents an innovative retrofitting approach for fluorescent lamps.

And now, enjoy your read!

Yours Sincerely,



Siegfried Luger

Luger Research e.U., Founder & CEO
LED professional, Trends in Lighting, LpS Digital & Global Lighting Directory
International Solid-State Lighting Alliance (ISA), Member of the Board of Advisors
Member of the Good Light Group and the European Photonics Industry Consortium

LIGHTINGEUROPE
THE VOICE OF THE LIGHTING INDUSTRY

EPREL Guidelines

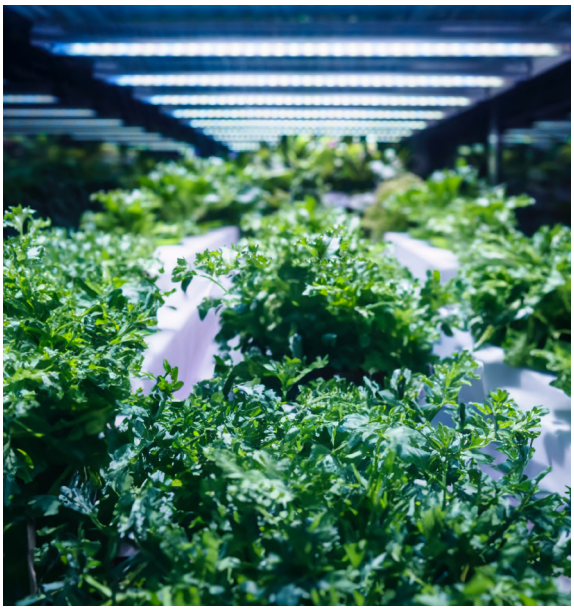
Have you registered your lighting products on the European Product Database for Energy Labelling (EPREL)?

LightingEurope is now making available to all companies our guidelines on how to comply with the EPREL registration obligations for lighting:

- What needs to be uploaded by when?
- Who should upload information?
- How do you upload information?

Covering the requirements in the new EU energy labelling rules for light sources (Regulation (EU) 2019/2015), including the changes introduced by the Omnibus Amendment (Regulation (EU) No 2021/340).

Discover more at www.lightingeurope.org



ADVERTISING INDEX

Putting Light Users First: Health, Well-being and Socio-Economic Impact

Jan DENNEMAN

Jan DENNEMAN is Founder and Chairman of the Board of the Good Light Group as well as Honorary Ambassador of the Global Lighting Association. The Good Light Group is a non-profit organization that promotes the use of Good Light indoors. Good light is daylight or electric light with comparable beneficial effects.

Jan has more than 40 years of experience in executive roles in sustainability, innovation and business development and held senior innovation and marketing roles at Philips Lighting (now Signify) during the industry's transition to LED and Intelligent Lighting Systems.

He founded several international consortia, such as the Global Lighting Association, Zhaga Alliance, the Connected Lighting Alliance and LightingEurope. Jan was President of the Global Lighting Association from 2007-2017 and President of LightingEurope from 2013-2017.

The scientific community is very clear about it. Indoors, during the day, we receive too little light, and in the evening and at night, we receive too much. This has consequences for our health and well-being. It disrupts our biological clock, which is a significant reason why one third of people report not sleeping well and feeling insufficiently rested and productive during the day. And this, in turn, affects our physical and mental health.

There is a lot of research and discussion about how important light is for our health and well-being. We spend more than 90% of our lives indoors, and while we can usually see well in indoor spaces, the light is not good enough for our health, because we are shielded from daylight.

Let's recap the main breakthroughs in our knowledge. At the end of the previous century, it was suspected that light in our eyes does more than just let us see. It also influences, to an extent, our alertness, and how we feel.

In 2002, new light-sensitive cells called ipRGCs (intrinsically photosensitive retinal ganglion cells), let's call them "spheres", were discovered in the retina. These cells are connected to the mood center and the biological clock in the brain, and they have little to do with vision. When the right patterns of light and darkness fall on these spheres, it synchronizes the biological clock to the 24 hour cycle. It is important to get the right light at the right time.

In 2017, the Nobel Prize in Physiology or Medicine was awarded to three scientists who described how the clock is generated in every cell. It was a significant recognition of the importance of light for our biological clock and our health. Extensive research has been conducted on the effects of light on our sleep, circadian phase shifting, and alertness. In 2020, a group of 18 chronobiologists, neuroscientists, sleep scientists, and light experts jointly made a recommendation on how much light people actually need for a healthy and happy life. The outcome is that during the day, people need at least 250 Melanopic Equivalent Daylight Illuminance (m-EDI lux) for an effective impact on their biological clock. In indoor spaces that are adequately lit for vision, people receive two to five times less light in their eyes than this recommendation during the day. And in the evening and at night, people receive far too much light.

These recommendations, following peer reviews, were officially published in March 2022, leaving no valid reason for not implementing them. The draft standard ISO 8995 for indoor lighting mentions these recommendations in Annex B.5. However, annexes are hardly read by anyone.

What else needs to happen to improve indoor lighting so that it doesn't hinder but rather promotes people's sleep quality and health? Currently, the main arguments for lighting focus on costs and return on investment based on energy savings, primarily benefiting building owners and facility managers. The next logical step is to focus on building users, paying attention to the biological rhythm, health, and well-being aspects of lighting. And this should be made financially viable: how much money can be saved when people are fit and alert at work, have fewer absences, function optimally, don't experience depressive feelings, and are less frequently ill? How much can society save on healthcare costs? These amounts far exceed the energy savings from lighting.

If we prioritize the health and well-being of building users, it is likely that good and healthy lighting will be chosen much more quickly. More than five billion people engaged in indoor activities during the day, cut off from daylight and relying on artificial light, will get a healthier and happier life. ■

J.D.

Good Light

For a healthier and happier life

Want to know more of the well-being benefits of Good Light?

www.GoodLightGroup.org

Good Light Group

The **Good Light Group** is a non-profit organisation that promotes the health and well-being effects of Good Light. If you support our activities and want to join as participant, let's get in touch!

info@GoodLightGroup.org

Elena Scaroni Assumes the Role of Secretary General for LightingEurope

www.lightingeurope.org

LightingEurope, the leading association representing the lighting industry in Europe, is delighted to announce the appointment of Elena Scaroni as its new Secretary General, effective June 26, 2023. Scaroni's promotion to this important role comes after her successful tenure as Policy Director since joining LightingEurope in September 2016.

Scaroni has been at the forefront of advocating for the European lighting industry's interests. Her expertise and leadership have been instrumental in driving the advocacy efforts concerning the latest Ecodesign and Energy Labelling Regulations for light sources. Before joining LightingEurope, Scaroni accumulated eight years of valuable experience in European Affairs at Enel, a multinational energy company. Her responsibilities included managing relationships with the European Parliament on all relevant topics such as climate, energy, and Corporate Social Responsibility. She studied in Rome and Paris, holding a master's degree in law and specializing in European Affairs.

"I am honored to take on the position of Secretary General for LightingEurope." said Elena Scaroni. "My first thoughts go to my predecessor, Ourania Georgoutsakou and to the LightingEurope team, who have made LightingEurope a leading trade association in the field of sustainable products and quality of light. Lighting is now recognized as one of the main contributors to indoor environmental quality and LightingEurope as a key actor asking policy makers that rules should be better enforced."

Elena Scaroni plans to work in full continuity with what has been achieved so far. "I am dedicated to advancing the lighting industry's agenda based on the work done with our members. I look forward to working closely with the industry stakeholders from the whole lighting value chain and policymakers."

"We are extremely happy and proud to appoint Elena Scaroni as the new Secretary General of LightingEurope," said Maurice Maes, President of LightingEurope. "Her impressive contributions as Policy Director and her many years of experience in the lighting and energy sectors make her the ideal candidate for this position. We are confident that Elena's leadership will drive LightingEurope forward, ensuring that the European lighting industry remains at the forefront of innovation and policy developments that support both the value of lighting and the industry's sustainability ambitions." ■

Ennostar Announces High-Level Appointment – Mr. Shuang-Lang (Paul) Peng

www.ennostar.com

Ennostar Inc. announced a high-level personnel change; the Board of Directors appointed Mr. Shuang-Lang (Paul) Peng as Chairman and President of Ennostar while Dr. BJ Lee is going to retire at the same time. The new personnel change took effect immediately. While being Chairman and President of Ennostar, Mr. Peng is also Chairman and Group Chief Strategy Officer (Group CSO) of AUO, the largest shareholder of Ennostar. As Chairman of AUO, he has led the AUO Group to reposition in the panel industry, apply technologies to diversified applications and become an innovative solution supplier with precise and long-term strategic management. Moreover, Mr. Peng has also successfully accelerated ESG development and smart manufacturing of the AUO Group and integrated group resources to boost its operational efficiency with the core value, "One AUO."

In his new role as Chairman and President of Ennostar, Mr. Peng will lead the Ennostar Group to be "The No.1 Investment Platform for Compound Semiconductors" and dedicated to developing "next-generation display," "automotive," "sensing," "special lighting," and "new-generation compound semiconductors" with perceptive market insight and better management on the supply chain. Especially, Taiwan's Micro LED supply chain holds a crucial position in the industry, while Ennostar plays an important role in it. In the critical timing of entering Micro LED mass production, Mr. Peng will strengthen supply chain integration and closeness and guide the company and its partners to speed up the path to success.

In addition to technology and market development, taking reference from AUO's successful synergy experience, Ennostar will stimulate the integration of group resources and platforms, enhance the group efficiency, maximize the group benefits, and proceed towards the group's common development goals with the spirit of "One Ennostar."

The Board of Directors also appoints Dr. Terry Tang as Chairman of Lextar, a subsidiary of Eurostar, while Dr. David Su steps down simultaneously. Eurostar Group sincerely appreciates the leadership and support from Dr. BJ Lee, the founder of EPISTAR, and Dr. David Su, the founder of Lextar, over the years. They have made an enormous contribution to the group and the LED industry with a professional technical background and insightful strategic management. In 2021, in response to the intense competition around the world, EPISTAR and Lextar integrated resources and founded Ennostar to provide total solutions with flexibility to meet customers' expectations. Considering the alternation of generations and the industry development, Dr. BJ Lee and Dr. David Su officially stepped down after wrapping up their work in the initial stage of the group development and passed the torch to the newly appointed management team in the third year of the establishment of Eurostar. In the future, Dr. BJ Lee and Dr. David Su will continue to offer consultations and support to work for the group development together as advisors.

Besides driving the group integration, Mr. Peng, along with the Board of Directors, will support and oversee ESG strategic direction and smart enterprise implementation, enhance enterprise resilience constantly and develop innovative technologies, and put the goal of being "The No.1 Investment Platform for Compound Semiconductors" into effect eagerly. ■

Current™ Appoints Steve Harris as New CEO

www.currentlighting.com

Current™ has appointed Steve Harris as its new Chief Executive Officer, succeeding interim CEO Bill Tolley. Harris, an established business leader is recognized for his operational prowess, was most recently Executive Chairman of Shape Technologies Group in Kent, Washington. Ten weeks ago, Current™ announced a leadership change appointing Bill Tolley as its Interim CEO. The company explained that departing CEO Manish Bhandari was instrumental in leading the company through the pandemic and a transformative acquisition of Hubbell's C&I Lighting business. Tolley, who has a long Hubbell, Inc. executive pedigree, will remain with Current™ as Chairman of the Board.

Harris has recent executive experience in the industrial sector. He was president and CEO of Shape Technologies Group for nearly ten years before transitioning to Executive Chairman in March. Shape Technologies Group is a manufacturer of ultra-high pressure pumps, waterjet cutting systems, and integrated robotic automation solutions.

Shape Technologies is also a portfolio company of the New York private equity firm, American Industrial Partners – the same private equity firm that owns Current™. American Industrial Partners states that Harris' former company, Shape Technologies has 1,343 employees and generates $452 million in revenue. Current™ employs 4,415 and cites $1.04 billion in revenue. ■

In Memory of Ian Ashdown

With intense sorrow, SunTracker Technologies announced the passing of our beloved friend, Ian Ashdown, PEng (Ret), FIES, Senior Scientist and co-founder of SunTracker Technologies Ltd.

Ian's profound passion and dedication to lighting, unwavering commitment to scientific integrity, and remarkable expertise have left an indelible mark throughout his extraordinary career spanning over four decades. His contributions encompassed a wide range of academic articles, lighting standards, and software developments. (See Ian's Bio)

Beyond his renowned reputation as an engineer and scientist in the lighting field and beyond, Ian possessed a remarkable spirit of compassion. He selflessly assisted numerous individuals personally and professionally throughout their journeys.

Ian's departure has left an immeasurable void; we deeply feel his absence. However, SunTracker Technologies remains unwavering in its dedication to preserving and advancing Ian's exceptional legacy within the lighting community and beyond.

For those wishing to convey their sympathies or have memories to share, don't hesitate to contact us at memorial@suntrackertech.com. A future Educational Scholarship will be created. ■

SOSLAB Enhances Strategic Cooperation with Global Automotive Lamps Maker SL Corporation

http://soslab.co

SLAB, a global leader of 3D high-performance LiDAR hardware and software technologies, and SL Corporation (KRX:005850), a global automotive lamps manufacturer, announced that they had entered into a technology development contract for the core LiDAR technologies and products with a goal of mass production.

Through distribution of its LiDAR hardware and software system parts, SOSLAB will provide autonomous driving and state-of-the-art safety functions for SL Corporation's automotive lamps. Based on the functions, SL Corporation is currently developing a LiDAR built-in lamp. The long-term goal of these companies is to supply the LiDAR built-in lamp to various vehicle models.

At the CES2023, SOSLAB presented LiDAR data to the audience by holding a live demonstration of ML-X, a high-performance LiDAR product, applied to lamps of Hyundai Motor Company's GV80. Compared to the existing products, the distance performance and resolution of ML-X have been more than doubled. Also, the size was reduced. With each resolution improved by three times, ML-X comes with an SOC developed exclusively for laser control in the transmitting unit. So, the overall product size and weight were reduced to 9.5x5.0x10.2□ and 860g respectively.

SOSLAB CEO Ji Seong Jeong said, "While working with SL Corporation, we have become convinced that LiDAR can be applied to car lamps, and that it is optimal in terms of price, performance, size, durability and sensor cleaning. We strive to be the last stander in the global LiDAR industry by providing LiDAR + lamp system suitable for new vehicle designs in the global finished vehicle OEM market."

SL Corporation's R&D manager said, "We are pleased to have entered into a contract with SOSLAB, a global LiDAR company equipped with excellent technologies and high-performance products. We look forward to making an epochal mark in the history of automotive LiDAR market based on close cooperation."

About SOSLAB
Established in 2016, SOSLAB attracted investment by approximately KRW 36 billion until last year with LiDAR, a core sensor technology for autonomous driving. With global top-tier companies as customers, SOSLAB is developing products for application to robots, smart city and smart factory in addition to autonomous vehicles. ■

Zumtobel Group Commits to the Science Based Targets Initiative

https://z.lighting

The Zumtobel Group is committed to the goals of the Paris Climate Agreement and has, for this purpose, joined the Science Based Targets initiative (SBTi). Together with over 4,000 participating companies worldwide, this initiative aims to contribute to limiting global warming to 1.5°C on the basis of science-based, individual targets. The Austrian lighting group is hereby committed to reducing CO_2 emissions along the entire value chain in line with science-based net-zero targets.

Further reduction of CO_2 emissions
With the aim of achieving climate neutrality in Scope 1 & 2, the Zumtobel Group has been able to halve their CO_2 emissions since 2021. Joining the Science Based Targets initiative involves the development of a roadmap that also includes the reduction of upstream and downstream Scope 3 emissions. These account for the majority of emissions along the value chain, including emissions related to purchased materials and energy consumption during the products' use. During the next step, a reduction plan is developed and submitted to the Science Based Targets initiative for validation.

"Joining the Science Based Targets initiative is a big step. We are taking responsibility for emissions that go beyond our own production: Reducing upstream and downstream emissions is now also part of our sustainability goals and will not only accompany us over the next few years, but guide us. Transformation and innovation will be essential building blocks on the way to net-zero." — Alfred Felder, CEO of the Zumtobel Group

"Now more than ever, we are well aware that we do not only want to act within our immediate control. We want to work with our partners, customers and suppliers to further reduce CO_2 emissions – only by working together we can move towards a sustainable future." — Sebastian Gann, Group Sustainability Director

About the Science Based Targets initiative
The Science Based Targets initiative has developed the first global standard that provides science-based targets to help companies make the Net-Zero Standard tangible. Step by step, companies can use these targets to decarbonize their core business and take responsibility for a fair share of emission reductions. SBTi assesses and approves companies' targets according to its own independent and strict criteria. More than 4,000 companies worldwide are already working with the initiative to limit global warming to below 1.5°C. ■

LIA Offers Guidance on Lamp Energy and Extends Relabelling Enforcement Deadline

www.thelia.org.uk/

A change in regulation to the energy labelling of lamps will come into force on 1st October 2023, enforcing that any lamps with the current energy labelling must be sold before this date. The Lighting Industry Association (LIA) offered guidance for the industry on how to prepare for the deadline and ensure that products were sold before that date.

The new regulations by the GB Ecodesign for Energy-Related Products and Energy Information (Lighting Products) Regulations 2021, SI 2021 No. 1095[1], required that by 1st April 2023 dealers replace any old light

source (lamp) energy labels (A++ to E rating) with the new rescaled label (A to G rating). The same requirement applied in the EU/NI from 1st March 2023.

The LIA and the British Retail Consortium (BRC) have been working closely together on this topic, assessing the size and scale of the problem and briefing DESNZ that disruptions to supply chains, reduced retail demand and staff shortages would result in a significant volume of lighting products being still on the UK market with the old A-D Energy Label after the deadline of 1st April 2023.

The LIA, and the BRC, were therefore very pleased to secure a six-month delay to this GB relabeling date from DESNZ/OPSS until 1st October 2023.

Ayça Donaghy, CEO of the LIA, commented: "We would like to thank Lord Callanan, Minister for Energy Security and Green Finance at the Department for Energy Security and Net Zero (DESNZ), and the team for listening to our concerns and subsequently granting the needed extension. As well as talking directly to DESNZ, the LIA helped its members lobby their local MPs – both showing the value of an effective industry association to its members, doing their job of supporting and representing their membership. This extension will grant those in the industry valuable time to prepare their products for the new market regulations in October."

Firstly, companies should now ensure they contact supply chain partners and make them aware of the extension. Following this, the LIA have put together a helpful guide, available to the entire lighting industry, with strategies to reduce stocks featuring the old energy label. Tips to reduce stock already in place include stock rotation, promotions, and donation.

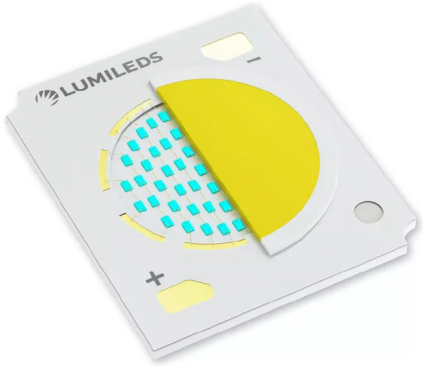
Bob Bohannon, Head of Policy and Sustainability at the LIA, added: "It is our responsibility as an industry to use the six-month extension granted by DESNZ. The LIA are proud to spread awareness and guidance for those in the industry, encouraging companies to work with up and downstream supply chains, rotate stock on shelves to ensure any old labelled stock is at the front, sell stock through and ultimately relabel any remaining stock with the new A-G label. We are hopeful that with our support, companies will be in a better position to prepare themselves for October and reduce any losses by ensuring stock can be sold."

About the LIA
The Lighting Industry Association (LIA) is the largest trade association in Europe dedicated to representing and serving the lighting industry. ■

Featured insertion

Lumileds 5th Generation CoBs Get 15+% Increase in Light Output and 20+% Increase in Efficacy

https://lumileds.com/products/cob-leds/



Lumileds has released its 5th Generation CoBs in the Core Range and Core Range PW lines elevating output and efficacy and particularly for 90CRI parts. Output and efficacy increases for high-CRI parts are critical for the retail and hospitality industries in particular, in which CoBs play a vital role as the source for spot and area lighting.

"Our new 5th Generation CoB LEDs serve lighting manufacturers' need for more light, higher efficacy, better than ever quality of light, and reliability they can count on," said Noman Rangwala, Global Product Manager at Lumileds. "The significant performance increases are the direct result of our unique phosphor mix and LED manufacturing experience, and our commitment to continuously advance the state-of-the-art as we address the needs of lighting manufacturers."

Lumileds tests and measures its CoBs per the European Union's Ecodesign Directive and by these standards, 90CRI LUXEON Core Range CoBs have increased one full class. Complete energy specifications can be found on the European Product Registry for Energy Labeling (EPREL) website.

Phosphor advances also contribute to superior color stability as the latest LUXEON Core Range CoBs are dimmed. This performance is especially critical in retail installations in which spotlights are often positioned at different distances from the merchandise. To achieve even illumination, some of the lighting is dimmed and that can result in uneven color in the beam and visual effects on the merchandise. To resolve this common problem, Lumileds focused on color stability over dimming to ensure even color throughout the light beam regardless of dimming intensity.

LUXEON CoB Core Range Gen 5 and Core Range PW Gen 5 are available now through Lumileds global distribution network. Product details, specifications and datasheets are available at https://lumileds.com.

About Lumileds:
For automotive, mobile, IoT and illumination companies who require innovative lighting solutions, Lumileds is a global leader employing approximately 7,000 team members operating in over 30 countries. Lumileds partners with its customers to push the boundaries of light. ■

Lumileds Broadens CoB Offerings With New Board Footprints For Absolute Design Flexibility

https://lumileds.com/products/cob-leds/

Though there are many standards in the LED industry, the footprint or board size for CoBs is not one of them. Over the years, companies that manufacture CoB holders and optics have largely designed their products to support the 3 board formats that are widely adopted by lighting manufacturers. With the introduction of LUXEON CS CoBs, Lumileds now offers a full range of LUXEON CoBs in each of the common board footprints.

"OEMs choose to implement LUXEON CoBs for better efficacy, color stability, and or reliability, but they don't want to have to redesign their system," said Noman Rangwala, Global Product Manager at Lumileds. "Now with the CS CoB range, it's easy for lighting manufacturers using many of the common square board configurations to switch to LUXEON."

The LUXEON CS CoBs incorporate all the advances that Lumileds has implemented and match the performance of the company's Core and CX CoBs. The CS Range is a general-purpose, high-performance CoB portfolio. The CS Pro CoBs are spectrally tuned for retail lighting where a "brighter and sharper" effect on merchandise is desired. The CS HE delivers even higher levels of efficacy for applications where energy efficiency is the driving characteristic.

The new LUXEON CS Range CoBs are available now through Lumileds global distribution network and complete details for all the products can be found at https://lumileds.com/products/cob-leds/. ■

Luminus Releases LUX COB Series with 90 and 95 CRI Minimum

https://luminus.us3.list-manage.com

Luminus Devices is excited to announce the immediate availability of the LUX COB series. These innovative new COBs are available in both 90 and 95 CRI minimum and LES sizes from 4 to 22mm in a variety of flux densities and a full range of CCTs.

The 90 CRI minimum delivers high-quality of light with the lumen/watt efficacy of an 80 CRI source, thus enabling luminaire makers to reduce SKUs by eliminating the need for 80 CRI products. Both the 90 and 95 CRI minimum versions use narrow-band red phosphor (Current KSF) technology to deliver outstanding performance and quality of light for a variety of lighting applications including retail, residential, hospitality, architectural, museum, downlights, track lights, and spotlights.

Dave Davito, COB Product Line Director at Luminus adds, "The LUX COB series is an exciting addition to the Luminus COB portfolio as they are available in not only 90 CRI minimum, but we went a step further to offer an optional 97 CRI typical, 95 CRI min, with efficacy similar to what our competitors' 80 CRI COBs have been delivering in recent years. For example, the LUX 95 CRI min CLM-22 provides 157 lumens/W and the 90 CRI version reaches an amazing 176 lumens/W. Luminaire makers who received prototype samples have already been loading orders on us faster than any new product in our 10-year COB history."

Luminus has developed a reputation in the LED market as the leader in quality of light, and lighting designers are specifying Luminus in projects where their end users are most discerning and demanding, such as retail lighting, museums, hospitality, and high-end residential. The launch of the LUX COB series further solidifies Luminus' leadership position and does so without having to sacrifice efficacy. European customers in particular are planning to leverage the LUX COBs to help their end customers qualify for energy efficiency rebates, which require the entire fixture system (including optics and drivers) to achieve 120 lumens/W. Since energy costs have risen sharply worldwide, and everyone is demanding a higher quality of light in parallel, the timing of the Luminus LUX COB product release is fortuitous indeed. ■

Nichia Expands the Portfolio of its Clear White Color LED, Providing the Joy in Life for Senior Citizens

https://led-ld.nichia.co.jp/en

Nichia, the world's largest LED manufacturer and inventor of high-brightness blue and white LEDs, is pleased to announce an addition to the Clear White color LED portfolio, the new 1W LED (NF2W757GR-V4H6: sm78xu/Rc0ac).

The Clear white color LED, with its clear white color geared to support the joy of sharper vision for senior citizens, has been developed by combining Nichia's expertise and technology in phosphors and LEDs cultivated over many years. It improves senior citizen's visibility and makes eating, reading, and other activities more comfortable, thereby supporting a more vibrant life. In January 2023, Nichia first launched a 0.2W version (NFSW757H-V1H6: sm78xu/Rc0ac) and garnered great feedback, including a BrightStar Award from LEDs Magazine. With the launch of the 1W 757 version, customer's options will be expanded. Nichia expects this to be used in a wider range of applications now, including downlights.

Nichia has been engaged in product development with a desire to enable the growing aging population to have healthy and comfortable lives with LED lighting, and the Clear White color LED is the one developed with this in mind. Nichia believes that the adoption of the Clear White color LED in residences, nursing homes, and all other living spaces will enrich the daily lives of the senior citizens through light. ■

Cree LED Precision Dimming: Better Control, Simple Binning

www.cree-led.com/news/precision/

Cree LED has utilized our extensive knowledge in LED performance and manufacturing to tackle the issue of inconsistent LED dimming. Precision Dimming provides manufacturers of no-compromise, specification-grade lighting with a straightforward solution to address the issue of unacceptable LED light output and hue variations when using low□current dimming.

Our engineering team has developed a new method to bring consistency to applications that require precise dimming and are highly sensitive to low-input intensity and color performance. By introducing a straightforward fourth dimension called Precision Dimming, we have significantly enhanced the industry standard 3-dimensional binning, which encompasses chromaticity, voltage and flux.

Unlike competing solutions that just control for voltage, Precision Dimming controls for voltage as well as color rendering metrics, including CRI and TM□30 Rf, with just two Precision Dimming bins per CCT/CRI.

Features:

- Two performance levels available
- 6500K-2700K ANSI CCTs available
- 80 & 90 CRI minimum available
- RoHS and REACH compliant

About Cree LED
Cree LED offers one of the industry's broadest portfolios of application-optimized LED chips and components, leading the industry in performance and reliability. Our team delivers best-in-class technology and breakthrough solutions for focused applications in high power and mid-power general lighting, specialty lighting and video screens. With more than thirty years of experience, Cree LED develops products backed by expert design assistance, superior sales support and industry-best global customer service. ■

DALI Alliance Database Exceeds 5,000 Products

www.dali-alliance.org

The product database on the DALI Alliance website now contains more than 5,000 products from DALI Alliance members around the globe. The product database provides a public listing of all products that have successfully completed the DALI-2 certification program (including all D4i certified products), as well as all DALI version-1 registered products.

Products that are not listed in the database are not certified, and are not entitled to use the DALI trademarks. DALI-2 certification is only available to DALI Alliance members. The database contains products from more than 230 brands.

Breakdown by product type:

In a snapshot view, taken recently, the database contained a total of 5,036 products. Of these, there were 3,433 DALI-2 certified devices, and this number increases every day.

The balance of 1,603 devices were DALI version-1 control gear. Registration of DALI version-1 devices is now closed, but when available it was only open to control gear, meaning that there are no DALI version-1 sensors or application controllers.

Among the 3,433 DALI-2 products were 2,794 DALI-2 control gear (which are mostly LED drivers), as well as 378 DALI-2 application controllers and 299 DALI-2 input devices.

Among the DALI-2 control gear were 265 devices that enable color control through the implementation of Part 209 (also known as DT8, or device type 8).

Also, there were 813 self-contained emergency control gear implementing Part 202 (also known as DT1). These include both DALI-2 and DALI version-1 control gear.

D4i certification is part of the DALI-2 certification program, and D4i devices implement a specific set of features. Parts 207 and 250-253 are mandatory for D4i control gear. There were 334 D4i LED drivers in the total of 2,794 DALI-2 control gear.

All DALI-2 devices can implement different combinations of features. The filters in the database allow users to select products with the required feature set. The new "advanced search" option also allows filters that remove products with certain features from the search results. ■

Autonomous Mesh Network System For Lighting

https://simplyleds.com

SimplyLEDs, a U.S. manufacturer of premier LED luminaires in Boise, ID, since 2010, releases SensaBLE 2.0, a next gen mesh network control system for lighting that virtually eliminates downtime and crushes kWh savings goals.

"Why did we develop our own lighting controls? It's still the Wild West out there." said Stephan Schmitt, President and CEO of SimplyLEDs, "Most lighting controls, in particular those for demanding commercial applications, don't live up to their hype. They are complex to install and operate, consume bandwidth, and fail to connect reliably. They are the under performers of the lighting industry and too many of these controls systems are torn out soon after their installation—our customers deserve better.

"We've been laser-focused on developing SensaBLE 2.0 as a robust system with unmatched reliability and performance, and it's paid off—our patent pending autonomy nearly eliminates downtime, and our entire system is designed to grow with our customers. From single point control lights to meshed fixture groups, to large multi-site installations, SensaBLE allows you to start small and grow exponentially. We're launching SensaBLE 2.0, integrated into our premiere product lines: FLD-RS for area and parking; and our ALD-R spec grade retrofit system. This integration ensures we stay in lockstep with the quality, service, and support that is our gold standard. Plus, with our US-based development team and a scalable cloud architecture, custom integration into existing systems or expansion into other IoT applications is within reach."

Todd Hubbard, VP of Business Development, believes tapping the brakes led the team to deliver a gamechanger. "Watch, listen, learn, then deploy. We don't engineer in a vacuum, we never have. Our goal is to provide innovative solutions that are customer-driven. Even in the pilot stage we spent months with our boots on the ground—in the field with our customers—honing and perfecting the system. We discovered the hot buttons: Downtime and Simplicity. Our motto is Control-Customize-Crush. But you can't do that with your kWh if you're battling downtime.

"With our autonomous network system, we're giving our customers a real chance to use the full capability of the system without interruptions. And with our focus on simplicity, customers can easily analyze their own data, make adjustments, and exceed their energy goals while adding to the bottom line and reducing their carbon footprint. We all agree: kWh deserve no mercy—the planet does."

SensaBLE 2.0 is a luminaire level lighting control (LLLC), mesh network system for outdoor lighting, available as a local app-based system or cloud-based system, providing multi-site monitoring, and complete control and customization.

Operating on a cellular network completely outside of any IT infrastructure, SensaBLE 2.0 eliminates security risk and the need for negotiations with IT departments, no Interconnection Security Agreements needed. ■

IR Sensor Modules Provide Robust Operation in Direct Sunlight

www.vishay.com

Vishay Intertechnology, Inc. introduced two new fixed-gain infrared (IR) sensor modules designed to lower costs and increase stability for outdoor sensor applications. Offering typical irradiance of 1.3 mW/m² in compact Minimold packages, the surface-mount TSSP93038DF1PZA and leaded TSSP93038SS1ZA provide robust operation in direct sunlight, while still providing enough sensitivity for light barrier applications.

Unlike high sensitivity fixed-gain IR sensor modules that require attenuators like dark panels, apertures, and sunshades to protect them against sunlight — adding to overall solutions costs — the controlled sensitivity of the Vishay Semiconductors devices released today allows them to operate in full sunlight without unwanted pulses. In addition, for short range presence and proximity applications, the sensors' reduced sensitivity eliminates the need for extremely low emitter forward currents, which can lead to unstable intensity outputs.

Featuring a fast 260 □s reaction time, the TSSP93038DF1PZA and TSSP93038SS1ZA deliver long range proximity sensing (1 m with TSAL6100 at 100 mA). With the same setup, a range of 11 m is possible in light curtain applications. Longer ranges can be achieved by using a more focused emitter like the VSLY5940 or by increasing the emitter forward current.

The devices are ideal for sensing the distance to objects for toys, drones, robots, and vicinity switches; presence detection for traffic control lights and parking lot, gateway access, and water level sensors; and light barriers for sports racing and lawnmower robots. They may also be used as reflective sensors for hand dryers, towel or soap dispensers, water faucets, toilets, vending machine fall detection, and security and pet gates.

The TSSP93038DF1PZA and

TSSP93038SS1ZA operate over a supply voltage range from 2.0 V to 3.6 V, feature a low supply current of 0.35 mA, and are sensitive to a carrier frequency of 38 kHz. Designed to receive IR pulses from an emitter with a peak wavelength of 940 nm, the devices are insensitive to ripple noise on the supply voltage and provide shielding against EMI, while an IR filter suppresses visible light. The modules are RoHS-compliant, halogen-free, and Vishay Green.

Samples and production quantities of the new sensors are available now, with lead times of six weeks.

Vishay manufactures one of the world's largest portfolios of discrete semiconductors and passive electronic components that are essential to innovative designs in the automotive, industrial, computing, consumer, telecommunications, military, aerospace, and medical markets. Serving customers worldwide, Vishay is The DNA of tech.TM Vishay Intertechnology, Inc. is a Fortune 1,000 Company listed on the NYSE (VSH). ■

Actility, Abeeway, and Combain Unite for AI-Powered Indoor Location Solutions Revolution

www.combain.com

Combain, Actility and Abeeway, are thrilled to announce their strategic collaboration, marking a new era of AI-powered indoor location solutions. This groundbreaking partnership brings together the expertise of three industry leaders in IoT connectivity, geolocation services, and advanced positioning technology to revolutionize indoor navigation.

The partnership between Actility, Abeeway, and Combain will focus on creating a comprehensive solution for Wi-Fi and Bluetooth-based indoor geo-location. By combining their respective technologies, the companies aim to deliver a cutting-edge indoor positioning system that leverages AI algorithms and deep learning techniques. Combain leverages AI to train an artificial neural network using ground-truth geolocations Wi-Fi and Bluetooth MAC addresses and signal strength. This innovative approach surpasses traditional trilateration methods delivering a remarkable reduction in median error.

Indoor geolocation services for LoRaWAN devices will be a key area of focus for this partnership. The collaboration will drive cross-promotion and lead generation for both businesses, opening new opportunities in the rapidly growing market of indoor positioning solutions:

- Actility, a global leader in IoT connectivity solutions, will contribute its extensive experience in network infrastructure and cloud-based services.
- Abeeway, a subsidiary of Actility, brings its expertise in geolocation technologies, including Low-power GPS, GPS, Wi-Fi sniffing, and Bluetooth Low Energy Beaconing.
- Combain, renowned for its advanced positioning technology and vast database of cell IDs and Wi-Fi/BLE positions, will provide its AI-powered indoor location solution.

This partnership comes at a time when the demand for AI-powered indoor location services is at an all-time high. As businesses strive to provide seamless navigation experiences and personalized services to their customers, Actility and Combain are poised to meet these evolving needs with their combined expertise, innovative technologies, and market reach.

"It's a pivotal time for Combain. We're eager to bring our deep learning-powered indoor positioning technology to Actility's broad LoRaWAN customer base. We believe this partnership will accelerate innovation and bring substantial value to our customers."
Björn Lindquist, CEO of Combain

"We're thrilled to partner with Combain to bring our innovative geolocation services to a wider range of devices and applications. This collaboration not only expands our technology capabilities but also allows us to enable us to deliver comprehensive indoor geolocation solutions for LoRaWAN devices, addressing the growing demand for precise and reliable indoor positioning."
Olivier Hersent, CEO of Actility

The collaboration between Actility, Abeeway, and Combain represents a significant milestone in the realm of indoor location services, promising to unlock new possibilities for businesses seeking to improve customer experiences, optimize operations, and gain valuable insights from their indoor spaces.

About Actility
Actility is the world leader in low-power wide-area networks (LPWAN) industrial-grade connectivity solutions for the Internet of Things. Actility provides its ThingPark™ platform and network technology to deploy, operate and maintain public and private wireless IoT networks within a unified, scalable, and versatile network infrastructure. Most nationwide network service providers (over 50) and thousands of enterprises trust ThingPark™ all over the world. Through its subsidiary Abeeway, Actility also provides patented ultra-low power tracking solutions. ThingPark Market offers the largest selection of interoperable IoT gateways, devices and applications to simplify and accelerate deployment of numerous use cases. For more information, visit www.actility.com/contact.

About Combain
Combain is a world-leading provider of geolocation services for connected IoT devices. Combain has created one of the world's largest positioning databases used for precise indoor and outdoor positioning. Combain also has developed new innovative positioning technologies, such as a new indoor positioning system that uses deep learning and an easy to deploy IoT asset tracking platform, Traxmate.

Combain's customers are leading mobile network operators, national security agencies, tracking devices and IoT device manufacturers. Positioning is provided as a cloud-based and OnPrem API, Combain Location API, as an indoor positioning solution, Combain AI Indoor, as a network positioning solution, Combain LMF, and as a cloud-based IoT tracking platform, Traxmate. Combain is located in Lund, Sweden and in Palo Alto, USA and serves customers worldwide. ■

onsemi Launches End-to-End Positioning System

www.onsemi.com

onsemi, a leader in intelligent power and sensing technologies, launched an end-to-end positioning system that enables the simpler and faster development of more accurate, cost- and power-efficient asset tracking solutions. The system is based on onsemi's RSL15 MCU, the industry's lowest power Bluetooth® 5.2 MCU, and incorporates software algorithms and components provided by Unikie and CoreHW, resulting in a fully integrated solution with components that have been optimized to work together.

The new Bluetooth Low Energy (Bluetooth LE) solution enables tags to be used for tracking objects or persons with sub-meter accuracy in defined closed spaces such as warehouses, stores or other buildings. It is scalable to large volumes of tracked objects in terms of performance and cost while reducing the amount of development effort and time-to-market.

With several new advanced features, the RSL15 is ideal for various industrial automation applications, including asset tracking, smart retail and IoT edge nodes.

Accuracy: The RSL15 Bluetooth 5.2 MCU supports longer range, higher data transmissions and localization through Angle of Arrival (AoA) and Angle of Departure (AoD).
Power Efficiency: onsemi's innovative smart sensing feature allows the Arm® Cortex®-M33 processor to remain in deep sleep while continuing to monitor sensor interfaces.
Security: The RSL15 is designed with Arm TrustZone® and Arm CryptoCell™-312 technology to establish a device's root of trust and to protect code and data authenticity, integrity and confidentiality. PSA Level 1 certified, this design enhances the security measures already offered in the Bluetooth protocol for assurance at both the data and application levels.

Unikie, a pioneering engineering company focused on enabling smart spaces, developed the software algorithms and components to calculate the real-time positions of a Bluetooth LE-based tag, using the IQ values for the received signals. Unikie's high-performance localization software is packaged as the Unikie BLE Localization Engine product for edge or cloud deployment. In addition, Unikie's APIs can be easily integrated into enterprise systems and data analyzers.

CoreHW, a fabless semiconductor company developing Integrated Circuit (IC) technologies, provides Bluetooth Angle of Arrival (AoA) development kits to a range of industries, enabling them to leverage indoor location systems for enhanced location-based applications. CoreHW designs and supplies Bluetooth LE enabled antenna array boards in various form factors that offer highly accurate location capabilities at a 10-centimeter level.

About onsemi
onsemi (Nasdaq: ON) is driving disruptive innovations to help build a better future. With a focus on automotive and industrial end-markets, the company is accelerating change in megatrends such as vehicle electrification and safety, sustainable energy grids, industrial automation, and 5G and cloud infrastructure. onsemi offers a highly differentiated and innovative product portfolio, delivering intelligent power and sensing technologies that solve the world's most complex challenges and leads the way to creating a safer, cleaner and smarter world. onsemi is recognized as a Fortune 500® company and included in the Nasdaq-100 Index® and S&P 500® index. Learn more about onsemi at www.onsemi.com.

Featured insertion

MetroSpec Technology® announces Powerful New FlexRad® FacetCore™ Configuration

https://flexrad.com

MetroSpec Technology®, the leading American manufacturer of custom LED light sources, announces a powerful range of configurations for its unique FlexRad® FacetCore™ technology. MetroSpec can provide preformed FacetCore assemblies with as many sides as needed to be used to make globes, pendants, sconces, and a wide variety of fixed and hanging fixtures.

This lightweight light source is easy to assemble and simple to replace existing fixtures, taking out costly metal and COBs. The same FacetCore product can also be used as single wide strips to accommodate other linear fixtures. Available in just about every color and CRI, FacetCore is the ideal choice for Industrial, Architectural and Commercial fixture manufacturers.

FlexRad includes a variety of technologies that allow fixture manufacturers to fill almost any shape with light. The novel applications of FlexRad also include Cut2Fit, Dually, Linear360, Hashtag, BoardonCoil, Dim2Tone, and 4Tone. In all of its forms, FlexRad is the most powerful, versatile, and most reliable LED light technology available. As with all MetroSpec products, FacetCore can be customized to perfectly fit all customer requirements.

Vic Holec, Founder of MetroSpec Technology, discussing the advantages of FacetCore states, "MetroSpec's mission is to enable North American light fixture manufacturers to efficiently build light fixture forms simply with less material and labor. FacetCore, for example, can cut up to 50% of the cost and more than half of the components out of fixture designs using it. It is simple and extremely powerful - perfect for cylinders, pendants, and sconces - without making tradeoffs in size and appearance."

Informational sheets and videos for FlexRad® products can be found on their website: FlexRad.com. For more information on FlexRad, please click here or email: sales@flexrad.com.

About MetroSpec Technology
MetroSpec Technology is an LED light source manufacturing company specializing in custom flexible, high quality, high intensity lighting solutions tailored for light fixture manufacturers producing high-end commercial, architectural, and hybrid lighting systems. MetroSpec offers quick development for all of their patented FlexRad LED light engines made exactly to custom specifications. FlexRad is innovative, field proven and customizable to any shape and size with optional wires, connectors, or PMount™ press-in-place fasteners.

MetroSpec Technology is located minutes from the Minneapolis-St. Paul International Airport in St. Paul, Minnesota. ■

Inductor: Highest Saturation Current in a Tiny Space

www.we-online.com

Würth Elektronik presents WE-HEPC, its smallest NiZn-ferrite based self-shielded power inductor to date. Thanks to a new and completely automated manufacturing process, these inductors provide consistent very high quality and a higher saturation current than any previous own or known competitive product.

In all, there are 15 models available with different attributes (L: 3.3 100 □H; ISAT: 1.3 3.3 A) and in package sizes 5030 (4.8 x 4.8 x 1.8 mm) and 6030 (5.9 x 5.9 x 2.85 mm).

WE-HEPC is suitable for DC/DC converters, filter applications, embedded computers, and other compact design applications. Due to its AEC Q-200 Grade 1 rating, it can also be used for some automobile applications. The operating temperature range spans -40°C to +125°C. The land pattern is compatible with older WE-SPC and WE-TPC inductors, giving customers a maximum amount of design flexibility.

Like all products in the Electronic Components 2022/2023, WE-HEPC is immediately available from stock in any quantities. Developers are welcome to request free samples. ■

Researchers Have Developed Next-generation Smart Textiles – Incorporating LEDs, Sensors, Energy Harvesting, and Storage

www.science.org

The international team, led by the University of Cambridge, have previously demonstrated that woven displays can be made at large sizes, but these earlier examples were made using specialized manual laboratory equipment. Other smart textiles can be manufactured in specialized microelectronic fabrication facilities, but these are highly expensive and produce large volumes of waste.

However, the team found that flexible displays and smart fabrics can be made much more cheaply, and more sustainably, by weaving electronic, optoelectronic, sensing and energy fiber components on the same industrial looms used to make conventional textiles. Their results, reported in the journal Science Advances, demonstrate how smart textiles could be an alternative to larger electronics in sectors including automotive, electronics, fashion and construction.

Despite recent progress in the development of smart textiles, their functionality, dimensions and shapes have been limited by current manufacturing processes.

"We could make these textiles in specialized microelectronics facilities, but these require billions of pounds of investment," said Dr Sanghyo Lee from Cambridge's Department of Engineering, the paper's first author. "In addition, manufacturing smart textiles in this way is highly limited, since everything has to be made on the same rigid wafers used to make integrated circuits, so the maximum size we can get is about 30 centimeters in diameter."

"Smart textiles have also been limited by their lack of practicality," said Dr Luigi Occhipinti, also from the Department of Engineering, who co-led the research. "You think of the sort of bending, stretching and folding that normal fabrics have to withstand, and it's been a challenge to incorporate that same durability into smart textiles."

Last year, some of the same researchers showed that if the fibers used in smart textiles were coated with materials that can withstand stretching, they could be compatible with conventional weaving processes. Using this technique, they produced a 46-inch woven demonstrator display.

Now, the researchers have shown that smart textiles can be made using automated processes, with no limits on their size or shape. Multiple types of fiber devices, including energy storage devices, light-emitting diodes, and transistors were fabricated, encapsulated, and mixed with conventional fibers, either synthetic or natural, to build smart textiles by automated weaving. The fiber devices were interconnected by an automated laser welding method with electrically conductive adhesive.

The processes were all optimized to minimize damage to the electronic components, which in turn made the smart textiles durable enough to withstand the stretching of an industrial weaving machine. The encapsulation method was developed to consider the functionality of the fiber devices, and the mechanical force and thermal energy were investigated systematically to achieve automated weaving and laser-based interconnection, respectively.

The research team, working in partnership with textile manufacturers, were able to produce test patches of smart textiles of roughly 50x50 centimeters, although this can be scaled up to larger dimensions and produced in large volumes.

"These companies have well-established manufacturing lines with high throughput fiber extruders and large weaving machines that can weave a meter square of textiles automatically," said Lee. "So when we introduce the smart fibers to the process, the result is basically an electronic system that is manufactured exactly the same way other textiles are manufactured."

The researchers say it could be possible for large, flexible displays and monitors to be made on industrial looms, rather than in specialized electronics manufacturing facilities, which would make them far cheaper to produce. Further optimization of the process is needed, however.

"The flexibility of these textiles is absolutely amazing," said Occhipinti. "Not just in terms of their mechanical flexibility, but the flexibility of the approach, and to deploy sustainable and eco-friendly electronics manufacturing platforms that contribute to the reduction of carbon emissions and enable real applications of smart textiles in buildings, car interiors and clothing. Our approach is quite unique in that way."

The research was supported in part by the European Union and UK Research and Innovation. ■

Fraunhofer – A New Solar Simulator to Test PV Modules

www.ise.fraunhofer.de/en

To pave the way for the industrial implementation of highly efficient perovskite-silicon PV modules, the tandem solar cells and modules must be reliably measured. Only then is it possible to make objective comparisons between different cells and modules and to make technological improvements. In contrast to conventional silicon PV modules, however, the calibration is considerably more challenging. A project consortium led by the Fraunhofer Institute for Solar Energy Systems ISE is therefore developing methods for characterizing perovskite-based tandem modules in the "Katana" project, funded by the German Federal Ministry for Economic Affairs and Climate BMWK. The solar simulator specially built for this purpose by the company Wavelabs Solar Metrology Systems GmbH is now in use in the CalLab PV Modules of the research institute."

Preparations for the industrial production of perovskite-silicon tandem solar cells and modules are already underway worldwide. "It is important to provide highly precise and reproducible measurements for this emerging technology as soon as possible so that there can be objective competition," says Prof. Dr. Stefan Glunz, Division Director for Photovoltaic Technologies at Fraunhofer ISE.

To be able to measure perovskite tandem modules, a comprehensive understanding of the contained solar cells is required. Dr. Martin Schubert, project head at Fraunhofer ISE, explains: "All cell layers must be irradiated by different light sources under conditions that imitate - as exact as possible - those under in sunlight in order to make reliable statements about the efficiency of the entire cell and module.

The new solar simulator in the CalLab PV Modules of Fraunhofer ISE, which has been completed for calibration, now makes this possible: It measures lab-scale perovskite-silicon PV cells with an area of 5 by 5 millimeters up to PV modules of 2.40 by 1.30 meters. The very large wavelength range of the simulator, ranging from 320 to 1650 nanometers is due to 28 different spectrally adjustable light channels distributed over 40 light sources with a total of 18,400 LEDs. This forms the basis for the test procedures developed by the researchers for perovskite-silicon tandem technology. The solar simulator also enables the characterization of multi-junction solar cells and modules made of other materials.

"The new solar simulator is a milestone towards a standardized calibration procedure for perovskite-silicon tandem modules. During its construction, we had to ensure that the LED illumination homogeneously irradiates the modules over the entire surface and that their light spectra can be adjusted so that all cell layers are realistically activated," says Falko Griehl, project manager for the SINUS-3000 Advanced solar simulator at Wavelabs. "With this technology, beyond the standard spectra, we can also simulate light at arbitrary times of day and regions, which allows this influence on tandem modules to be analyzed." From 2024, the heat generated by the longer illumination times during module characterization will be compensated by a climate chamber, in which the tandem PV cells and modules will be placed for measurement.

Perovskite solar cell pioneer and manufacturer Oxford PV is an associate partner in the Katana project. Dr David Bushnell, Oxford PV's Test and Measurement Department Manager, said: "The development of a new calibration capability for accurately determining the performance of perovskite-on-silicon cells and modules will enable high-quality independent measurements of this breakthrough technology. We are pleased to be supporting the wider PV community by helping to fund this project."

For the characterization of perovskite-silicon tandem solar cells and modules, the classic flash simulators, or flasher, from silicon photovoltaics cannot be used without further ado, since flashers cannot variably adjust the light spectrum that the tandem cells convert into electricity. Furthermore, the illumination time by a flasher is too short to account for the effects between the sub-cells. For the metastable behavior of perovskite technology, the solar cells and modules must be tested under continuous light. Until now, the efficiency of perovskite-based tandem modules had to be measured in complex and weather-dependent outdoor tests. ■

The Influence of a Photometric Distance on Luminance Measurements

www.mdpi.com

Luminance measurements are the least frequent of all photometric measurements. This article characterizes and systematizes the various methods of luminance measurement. In particular, the method of direct luminance measurement using modern luminance meters (ILMD) is described in detail. This paper presents the results of the study on the influence of the measurement distance on the luminance measurement results.

Two ILMD meters (laboratory and portable) and a luminance standard were used in this study. The conducted research showed that an incorrectly chosen measuring distance can lead to significant measurement errors of up to several tens of percent. In addition, the possible impact of incorrect measurements on the design of an interior lighting installation was presented. It was shown that the selected interior lighting installation can consume more than 40 percent more electricity compared to the installation based on the correct luminance measurements of the luminaires with diffuse shades. In the final stage of the study, the definition of the photometric test distance for luminance measurements using ILMD was proposed. The test results can be particularly useful for the luminance measurements of OLEDs or the luminaires with diffuse luminous character. However, these results can also be used for luminance measurements of other light sources and luminaires. ■

Negative Effects of Artificial Lighting on Male Glow-Worm Courtship Behavior

https://journals.biologists.com

Artificial lighting at night (ALAN) has detrimental effects on various aspects of insect behavior and ecology. A recent study focused on the impact of white illumination on male glow-worms, a species known for its bioluminescent courtship display.
The researchers conducted experiments using a Y-maze setup with a female-mimicking LED at one end. They found that as the intensity of the light increased, fewer male glow-worms successfully reached the LED. Those that did reach the LED took longer to do so and spent more time in the central arm of the maze, retracting their heads. Interestingly, when the artificial light was removed, the negative effects on the male glow-worms were reversed. These findings highlight the susceptibility of glow-worms and potentially other insect species to the disruptive effects of ALAN. Addressing the impacts of artificial lighting on ecosystems is crucial for preserving the delicate balance of nocturnal organisms and their habitats. ■

RTA Upgrades Tunnel Lighting Through 14,400 Eco-friendly LED Units

www.rta.ae

Dubai's Roads and Transport Authority (RTA) has replaced 14,400 traditional lighting units with contemporary, eco-friendly LED lights. This upgrade included at least 39 tunnels and crossings, spanning a total of 22.6 km.

RTA is deeply committed to energy conservation, strengthening Dubai and the UAE's standing in green economy and sustainability besides promoting a clean environment. In doing so, RTA is committed on implementing the best international practices to achieve financial sustainability through optimal utilization and extension of the lifespan of its assets. The project entailed re-engineering the operating systems of tunnel lighting units and night road crossings, with sustainable, eco-friendly lights.

"RTA recently renovated the lighting for 39 tunnels. This 6-month project, entailed some of Dubai's prominent tunnels including the Airport Tunnel, Shindagha Tunnel, Dubai Mall Tunnel, and the Dubai World Trade Centre Tunnel," statedMaitha bin Adai, CEO of Traffic and Roads Agency, RTA. "LED lighting units have many eco-friendly features, such as consuming 60% less energy than traditional lighting units and offering an increased lifespan by up to 177% in comparison to older lights. The new lights have a lifespan of 50,000 hours, compared to 18,000 hours for conventional lighting units, which reduces the frequency of light replacements and minimizes maintenance and operational costs. Furthermore, compared to traditional lamps there's a 20% reduction in energy loss and heat emissions, enhancing the efficiency of both the units' lighting operational system and the tunnels' energy supply network," added bin Adai. ■

LpS DIGITAL AWARDS 2023

At the annual LpS Digital Summit (December 2023), the LpS Digital Awards will be presented in four specific categories.

AWARD CATEGORIES 2023

Product Award
Sustainability Award
Scientific Paper Award
Achievement Award

SUBMIT YOUR PROPOSAL

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info@lps-digital.global

KAIZEN-propelled Lighting Solutions – Kanetaka SEKIGUCHI, President & CEO, CITIZEN ELECTRONICS

Kanetaka SEKIGUCHI:
"It is our employees' dream to keep supplying products of high value to the market. To realize this dream, we will contribute to the creation of new value through manufacture which is, in turn, propelled by each individual employee's *spirit for meeting a challenge*."

Citizen Electronics demonstrates its ability in producing parts and modules where small precision and high accuracy are required. They have developed an electronic device business focused on LEDs, and switch business with mechatronics applications.

https://ce.citizen.co.jp/e/

LED professional: **We are delighted to have the opportunity to conduct this interview with you. So please let us start with a review of your career.**

Kanetaka SEKIGUCHI: I joined CITIZEN WATCH CO., LTD. in 1981 where I was engaged in developing liquid crystal displays. For two years, from 1989 to 1991, I worked for a company in the Netherlands for joint development. In 2006, I moved to CITIZEN MIYOTA (current CITIZEN FINEDEVICE) CO., LTD., which was a group company, and took part in the development and commercialization of LCOS (Liquid Crystal Silicon). After that, at CITIZEN FINEDEVICE Co., Ltd, I worked to strengthen patents and I also applied for a patent myself. After contributing to quality enhancement of automobile parts and commercialization of combustion pressure sensors, I was instated as the CEO of CITIZEN ELECTRONICS in 2018.

LED professional: **Now let's talk about Citizen Electronics. Could you give us a brief history of the company?**

Kanetaka SEKIGUCHI: CITIZEN ELECTRONICS was founded as a joint venture with the American Bulova Watch Company, Inc., that dealt in tuning-fork watches, as Bulova Citizen in 1970. However, quartz watches began to appear the following year, which led to a stop in production and dissolution of the joint venture. Later, in 1989, through the use of IC mounting technology and substrate method for watches, we developed surface mounting type LEDs for the first time in the world. With the expansion of mobile phones in the market, we have established the status of an LED package maker by supplying LEDs to major mobile phone makers. Moreover, since the 2000's, as the market for LED for lighting was being established, we have focused on compatibility of high luminous flux and high efficiency as the main themes of development. We are proud that, as a result, we have been playing an important role in the market of LEDs for lighting by supplying COB (Chip on Board) type LEDs for mass production for the first time in the world. Even now, we continue to supply COB type products with high added value in the market of LEDs for lighting as one of the top suppliers, as well as SMD products for the consumer market and backlights for automobiles. In recent years we have aimed to create new value by concentrating on LEDs for horticulture and VCSEL, which are expected to experience market growth, together with working on the development of lasers and UVC.

LED professional: **Where is Citizen Electronics located globally?**

Kanetaka SEKIGUCHI: The headquarters and R&D are located in Fujiyoshida City, Yamanashi Prefecture. We have a total of four factories and eight sales offices in Japan and overseas. Our largest factory is in Jiangmen, China, which produces LEDs and tactile switches. The factory in Japan mainly produces products with high added value. The overseas sales offices are located in the U.S., Germany, Shanghai and Hong Kong and are globally networked. Research and development is conducted in-house, and also at the CITIZEN WATCH laboratory and group companies.

Headquarters building of CITIZEN ELECTRONICS in Yamanashi Prefecture, Fujiyoshida City.

LED professional: **What are the major product groups Citizen Electronics is offering the market?**

Kanetaka SEKIGUCHI: For the market of LEDs for lighting, it is the COB light source. As we pursue quality of light, not just improvement in efficiency, we have been supplying products with high added value, for example, high-color rendering and high-efficiency products (Type Y), VIVID Series, that express original colors more vividly, HI (High Intensity) Series, which provide a wide color lineup and easy light distribution control, and Type F, which have improved the evenness of lighting. We are planning to add characteristic SMD products to our lineup.

For the consumer market and backlights for automobiles, we supply the highly acclaimed small SMD products with a unique light distribution control.

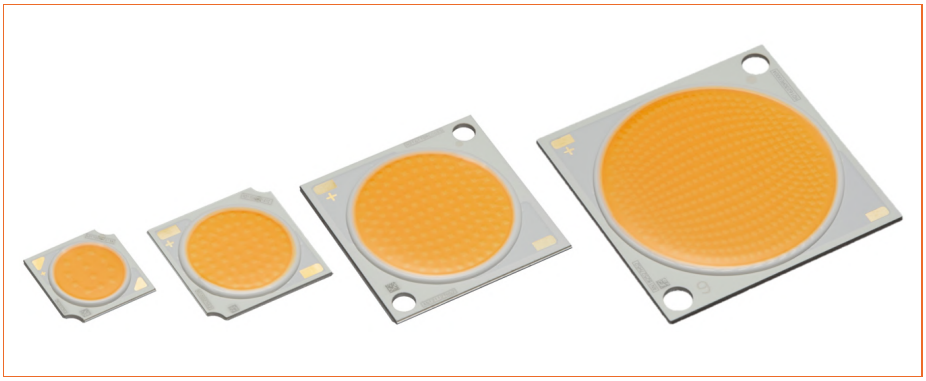
LED professional: Recently Citizen Electronics introduced Laser Light and UVC LEDs to the market. Can you tell us about these new innovations?

Kanetaka SEKIGUCHI: At this moment, our main business is products with visible light used for general lighting. In addition to those products, we plan to develop products with increased added value of light, such as products using invisible light (UV and IR) or laser light to expand our lineup. Our UVC products have realized high output power through the use of technology for COB type LEDs, and we aim to produce them at low cost and bring about their long service life. Also, we will commercialize laser light products by taking advantage of the small RGB package.

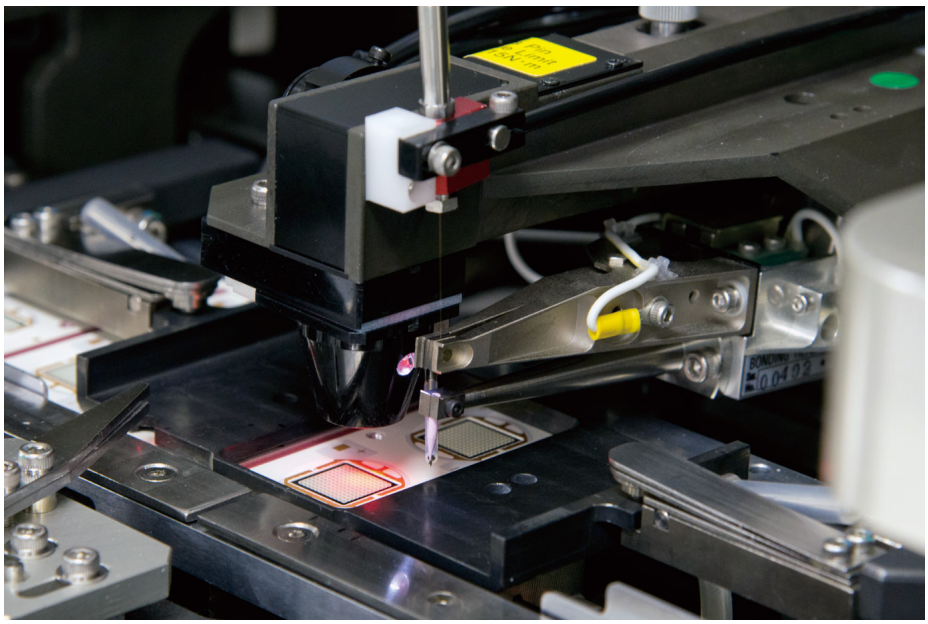
LED professional: Let's take a deeper look back into the development of the lighting sector. How would you summarize the last decade of the lighting world?

Kanetaka SEKIGUCHI: In the lighting sector, the market has been established through the accelerated development of LED light sources and in the intensified competition of cost and efficiency. In environmental fields, LEDs have made a great contribution to society by being mercury-free, having a long service life, and being energy-saving. The market is considered to be mature enough, however, products with an LED light source replacing the conventional light source are still the mainstream. We believe that we have yet to realize the true meaning of development of real LED lighting and luminaires that use an LED light source. From now on, downsizing of luminaires, optimization of the whole lighting that enables light distribution control, and realization of environmentally conscious products with high reliability and long service lives are what true LED lighting should aim for.

To achieve these goals, as a manufacturer of LED light sources, we will evolve to realize various requirements for function and performance necessary for LED light sources and contribute to optimization of the whole lighting system by providing added value.



CITILED Standard COB Series Version9.



Precision Packaging Technology: This technology includes Citizen Electronics' unique collective substrate fabrication technique, design development capability and fabrication technique of ultra-small and ultra-thin packaging.

(**Top, middle**) High-power UVC LED assembly: The product uses a high-power, deep ultraviolet (UVC) LED possessing a 265nm emission wavelength, which has a high germicidal effect. It can be used for surface disinfection and air disinfection, and also for water disinfection ensuring a safe water supply.

(**Bottom**) Small and high-heat dissipation RGB laser: Through use of Citizen Electronics' "small and high-heat dissipation package technology" that was created during their history of developing LEDs, they have succeeded in downsizing and realized inclusion of red, green and blue lasers in one package. They continue to further develop the product for AR glass and Pico projectors.

LED professional: Today we talk about some significant lighting trends, like Human Centric Lighting, Sustainability with Circular Economy, Intelligent/Data-Controlled Lighting, and Energy Efficient Lighting Solutions. In your view, which one or ones of those are the most important?

Kanetaka SEKIGUCHI: As those trends are linked closely together, it is difficult to choose one. However, in the Japanese lighting industry, further improvement of energy efficiency is essential. We believe that it is important to supply the best lighting for human beings and the environment, and systemization, data control, and high-efficiency solutions are the means to achieve this target. We would like to supply optimal light sources to meet various needs in the next-generation LED market by realizing variation of color including spectrum control, uniformity of the irradiated area, and pursuing development of a point light source that distributes light easily without sacrificing efficiency and high reliability.

Also, at our LED production sites, we always address the improvement of productivity and reduction of waste materials as the most important themes to realize a sustainable society.

"We will always implement KAIZEN in all areas from sales, design, production to shipment."

KANETAKA SEKIGUCHI

LED professional: Intelligent lighting, connected lighting and data management are also becoming more important. How does Citizen Electronics deal with these developments?

Kanetaka SEKIGUCHI: Although we light source manufacturers do not primarily design whole lighting systems, we believe it be our role to supply light sources that are required to optimize the whole lighting system and to make it more efficient. It is what our customers, namely luminaire makers, are trying to do. To carry out this role, we continue to develop high-efficient light sources with a long service life and outstanding properties of tuning and dimming.

"Miharu Takizakura," one of the three great cherry trees in Japan lit by CITILED VIVID Series (5000K).

LED professional: Where do you see Citizen Electronics in 5 years?

Kanetaka SEKIGUCHI: We plan to improve color, tuning properties and efficiency of LEDs for lighting, and at the same time develop SMD type products to expand our lineup. With regard to in-vehicle products, we will focus on products for car interiors.

In addition, we have three other targets.

- Enhance LEDs used in horticulture
- Extend the wavelength of our products from visible light to invisible light such as with ultraviolet rays and infrared, to raise the market value
- Create market value of LDs (laser diodes) through RGB three-color small laser packages. We will put more weight on non-lighting products such as products with invisible light and lasers, so that we can establish our position as a supplier in a wider market and with a broader range of applications.

LED professional: How do you manage CE, its people and the teams?

Kanetaka SEKIGUCHI: In a rapidly changing society like that of the present, unexpected events occur one after another, and they influence the whole global business. To survive in such a society, it is critical to obtain correct information as fast as possible, analyze it from a wide and unique perspective, and take action as fast as possible. To achieve this, we think it is important to continue to be "Citizen Electronics that customers can depend upon" by utilizing our world-wide sales network to its maximum, and by promoting prompt cooperation between the sales, planning and development departments to respond timely to customers' needs. Thus, our investment, including in human resources, will focus on products, the market and applications by selection and concentration strategy. In addition, we will always implement KAIZEN in all areas from sales, design, production to shipment. I manage CE so that we can exert our organizational power, not only individual power, and work together to improve the company as well as maintain what should not be changed.

LED professional: Thank you very much for the detailed interview, and we wish you, your team, and Citizen Electronics continued success!

Kanetaka SEKIGUCHI: It was great talking to you. Thank you very much. ■

For additional information please visit https://ce.citizen.co.jp/e/.

CITIZEN ELECTRONICS CO., LTD.

Lighting Control Systems for Agriculture

Steve ROBERTS, Innovation Manager at RECOM Power

LED lighting is gaining popularity in the field of agriculture, especially in animal husbandry, greenhouses, and indoor farming, where it provides several benefits over traditional lighting methods such as being maintenance-free and having a higher energy efficiency—LEDs convert more than 80% of the electricity they consume into light and consume 60% less energy for the same lighting intensity. However, the biggest advantage is spectrum control: different crops and animals require different wavelengths of light for optimal growth, yield, and well-being, and LED lighting can provide the exact spectrum needed with the added benefit that this spectrum can be optimized in real-time. This ability to fine-tune the color temperature makes LED lighting a cost-effective solution, even though its initial cost may be higher than that of traditional lighting methods.

The Importance of LED Lighting in Animal Husbandry

LED lighting is used in animal husbandry to improve animal welfare, growth, and productivity. Proper and adequate lighting is crucial for animal well-being and growth, and LED lighting can provide the exact spectrum of light needed for different stages of animal development.

For example, in poultry farming, UV and visible light LED lighting is used to regulate the circadian rhythm of chickens. The right amount and spectrum of light promotes increased egg production, reduces stress, and improves the overall welfare of the birds. As birds have a different visual response than humans (tetrachromatic rather than trichromatic receptors in the retina), they can perceive ultraviolet light that we cannot see. They use this ability to identify each other to establish their pecking order, and hens utilize it to assess the healthiness of their brood (healthier chicks have denser feathers that reflect UV light more strongly, so a mother hen can quickly identify weak from strong chicks). In low UV light conditions, poultry cannot use this extra sense and so become uncomfortable and even aggressive. Ideally, the illumination level should be 30–50 lux over 80% of the space (poultry also have a wider field of vision (300°) than humans (180°), and therefore the whole space needs to be well-lit with no dark or shaded areas that could be perceived as being a threat to the birds).

In dairy farming, LED lighting can be used to increase milk production. Dairy cows require a specific amount of light per day for optimal milk production (typically 150 lux for 16 hours per day), and LED lighting can provide the exact spectrum and intensity needed. Tests show that a 5–16% increase in milk yield can be achieved when the lighting is optimal compared to too dark or short lighting times. Like poultry, cows have a very wide field of vision and become unsettled by dark or shaded areas. Thus broad, even illumination is required. It is also important to have a period of low lighting (<50 lux) to allow the cows to rest properly. As cattle cannot see red light, LED lighting can also be switched to the red spectrum during this time to allow farm workers to check on the cows without waking them (**Figure 1**, **Figure 2**).

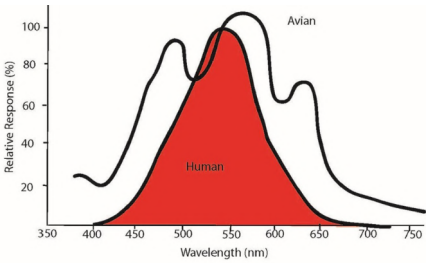


Figure 1: Comparison of avian and human phototropic response.

Figure 2: (**top**) "Daytime" illumination for optimum milk yield. (**bottom**) "Night-time" illumination is visible to humans but not to cattle.

The Benefits of LED Lighting in Horticulture

As previously mentioned, LED lighting offers precise spectrum control, which means that the light can be tailored to the specific needs of plants; the classic grow lamps radiate more strongly in the colors, magenta and blue. However, different wavelengths of light are required for different stages of plant growth, and LED lighting can provide the optimal spectrum for each stage. Another advantage is that it produces less heat and infrared radiation than traditional lighting methods, thus reducing the risk of heat stress on plants under high illumination levels. This is especially important in indoor farming and greenhouse cultivation, where temperature control is critical.

Figure 3: Vertical indoor farming using artificial light.

Indoor farming involves growing crops in an indoor environment using purely artificial lighting that allows for year-round crop production. Vertical farming involves growing crops in stacked layers, making it a space-efficient option for urban areas. LED lighting provides the necessary light for plant growth in each layer, reducing energy consumption and heat output. In hydroponic farming, plants are grown in a nutrient-rich water solution without soil, and LED lighting can offer the right spectrum of light for photosynthesis, allowing plants to grow faster and produce higher yields; it can also be customized to match the specific light requirements of different plant species. A variation on soil-less horticulture is aeroponic farming, where plants are grown in an air or mist environment, and aquaponic farming, where plants are grown in a water-based environment with fish. Again, LED lighting is used to provide the necessary spectrum of light for optimum plant growth and to support the growth of aquatic organisms. Indoor farming is becoming increasingly popular, especially in urban areas where space is limited. Here, LED lighting plays a critical role, as it provides the necessary light for plant growth while reducing energy consumption and heat output.

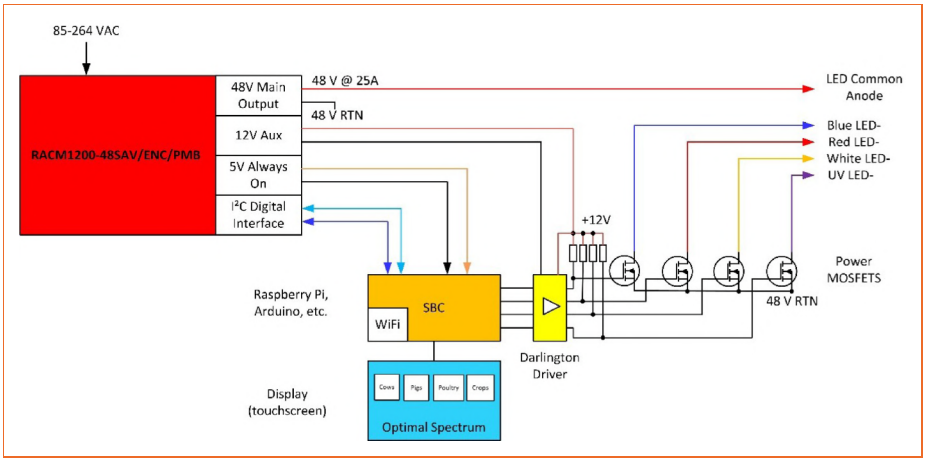


Figure 4: Block diagram of a simple universal LED lighting system that can be tuned for different livestock and plants with a dynamic color spectrum.

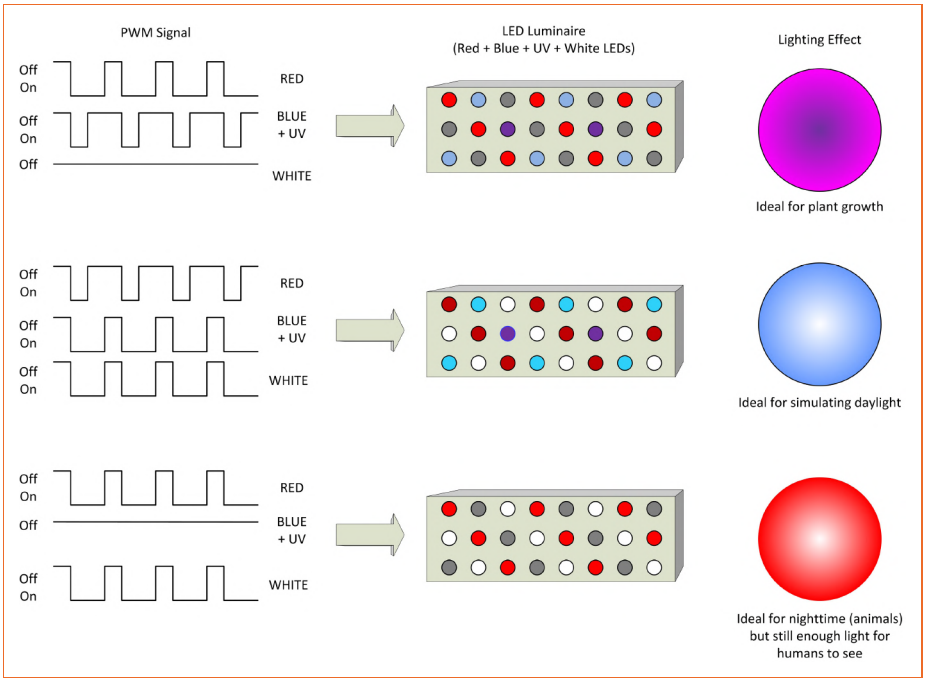


Figure 5: Varying the PWM signal for each bank of LEDs changes the apparent lighting (color temperature).

On a larger scale, LED lighting is used in greenhouse cultivation to provide the necessary light for plant growth, regardless of weather conditions. Artificial lighting is also used to extend the growing season, which means that crops can be grown outside of their normal growing season.

A Practical LED Solution for Agricultural LED Lighting

The schematic in **Figure 4** shows a concept for a very flexible and low-cost solution for large-area indoor LED lighting for agriculture. The heart of the system consists of a cheap single-board computer (SBC), such as a Raspberry Pi or an Arduino with a WiFi communication module and a small LCD (optionally with a touchscreen), plus a RACM1200[1] digital power supply capable of delivering 1000 W in a sealed, dust-tight, and fan-less enclosure.

The LED lighting control system can manipulate the color spectrum in real-time by individually dimming different banks of LEDs, while the SBC communicates with the power supply to switch the LED lighting on and off at pre-set times or to set the overall light intensity. Global dimming for lower power consumption can be achieved by adjusting the output voltage down via digital control.

The RACM1200 is ideal for this application because it has a separate “always on” 5 V output that will continue to power the SBC

[1] More information about RACM1200-V Series.

even when the main output is completely switched off; furthermore, it includes a separate 12 V fan output, used in this example to boost the logic level output of the I/O pins on the SBC to a higher voltage signal that can switch the power MOSFETs more efficiently and at full power.

The LED luminaires are operated at a safe 48 VDC, meaning that there is no risk that animals can be electrocuted if they chew on any exposed wiring and ensuring that the luminaires can be hung from the ceiling at the optimum height for even illumination although they are within easy reach of farm workers. In vertical farming, where each stack is individually lit at close quarters in a wet or damp mist environment, worker protection requires such safe extra-low voltage wiring. Of course, the RACM1200 is continuously short-circuit proofed and will not be damaged if the output is shorted.

The color temperature of the lighting is set by modifying the PWM signal from the SBC for each channel, offering more red, more blue, whiter, or more UV illumination as necessary (**Figure 5**). The LEDs are switched with a PWM signal at above 200 Hz so that poultry will not be disturbed by the flicker (humans cannot see flicker at 100 Hz or above, so many cost-effective LED power supplies have a very high output flicker at double the mains frequency of 50 Hz or 60 Hz. This can be a problem for birds who can perceive lighting flicker up to 190 Hz. The output of the RACM1200 is flicker-free and the PWM dimming is at a higher frequency than the animals can see).

The whole system can be fitted into an enclosure no larger than a shoebox, even though the RACM1200 is powerful enough to light a whole barn or greenhouse by itself (output power 1000 W without fan cooling). Another advantage is the wide input voltage range of 80–264 VAC so that even unstable or erratic main supplies to remote barns or distant outhouses are not a big problem. ■

For additional information please visit https://recom-power.com.

AUTHOR: Steve ROBERTS, Innovation Manager at RECOM Power

Steve ROBERTS was born in England. Before working at University College Hospital, he received a B.Sc. in Physics and Electronics from Brunel University, London. He later moved to the Science Museum as Head of Interactives, where he completed his M.Sc. at University College, London. Eighteen years ago, he made his personal Brexit and moved to Austria, where he became Technical Director of the RECOM Group in Gmunden. He is the author of the DC/DC, AC/DC & EMC Book of Knowledge.

About RECOM Power GmbH

RECOM manufactures a full range of standard and customized DC/DC and AC/DC converters in every power class from sub-1W to tens of kW, alongside switching regulators and LED drivers in a wide selection of formats. The company headquarters are located in Gmunden, Austria, and include a state-of-the-art logistics, research and development center, and laboratory wing and is supported by a worldwide distribution network. The RECOM name has become synonymous with high quality, integrity, innovation, and excellent customer service.

RECOM Power GmbH, Münzfeld 35; 4810 Gmunden, Austria. info@recom-power.com

Smart Home – The Journey from Cool Gadget to Ubiquitous Infrastructure

Musa UNMEHOPA, Head of Wireless Standards & Regulations at Signify

Smart Lighting has arguably been one of the more successful Smart Home use cases over the past years. Lighting companies, from all regions around the globe, offer wireless lighting control products, and connected lamps and luminaires, as part of their portfolios. But it has not been without challenges. And other smart home use cases beyond smart lighting, such as smart home energy management (thermostats, air conditioning, heating and ventilation), smart home safety (window and door sensors, proximity and motion sensors, cameras), smart home access control (door locks, gates, shades and blinds) are facing many of the same challenges. As a result, the Smart Home is not ubiquitous yet. One complicating factor is that these challenges are present across the entire value chain, from consumers, to device manufacturers, to smart home ecosystems, all the way to retailers. Let's take a look at some of the challenges faced by these four stakeholder groups, and then present a solution that could benefit all of them, as we progress along the Smart Home journey from cool gadget to ubiquitous infrastructure.

The Challenges

Consumer challenge – As a consumer, I need to work out if the smart device that I picked out in the store, will actually work with the smart devices and the smart home ecosystem I already have in my home. And this is not just on the protocol level (e.g. do I have Zigbee in my home or something else), but also on the ecosystem or smart hub level (e.g. do I have Amazon Echo, Apple HomeKit, Google Home, Samsung SmartThings, etc.). Another issue I face as a consumer is that of support. If I buy a device from a company that later on discontinues their support, or the company goes under, my control app for that device stops working and I am left with a bricked device.

Device manufacturer challenge – As a device manufacturer, if I want to add connectivity to my traditional device, I often also need to provide an app, a cloud service, and sometimes even a hub. And I need to maintain that over time. Another consideration is the network effect, i.e. the value of my device increases if it can connect with as many other devices as possible. To this end, I may want to leverage an existing smart home ecosystem for my device to connect to. But which one do I pick? I either need to place a bet on which of those ecosystems will become the dominant player in my target market, or alternatively I need to integrate my connected device with each and every one of those ecosystems out there. Both these considerations, i.e. adding connectivity and integrating with existing ecosystems, adds development cost and time-to-market.

Ecosystem challenge – As an ecosystem provider, to attract device manufacturers and consumers to my ecosystem, I need to integrate all of the popular smart lighting provider with my hub or controller, and on-board them. Some I may be able to integrate on the local home network, others I may need to integrate in the cloud. I need to do that again with each future version of their product. And once I am done with smart lighting providers, I need to do it all over again for smart lock providers, smart thermostat providers, smart window covering providers, etc. For this reason, many ecosystem providers operate an extensive partner or "works with" program that involves extensive integration and regression testing. This adds development cost and time-to-market.

Retailer challenge – As a retailer, I need to educate my customers about which device works with which ecosystem, I need to work out which infrastructure is already available in the home of my customer in order for their purchase to be connected, and I need to deal with returned products if the onboarding experience is too cumbersome. And if I want to supply two or more ecosystems, I need to stock and reserve shelve space for device variations for each of those.

Essentially the smart home market is faced with a coordination challenge across the entire value chain that is inhibiting broader market adoption. What is needed is a concerted and deliberate effort to make sure that smart home devices from different brands made by different manufacturers, communicating on different wireless protocols, across different ecosystem platforms, on different operating systems, all work seamlessly together. Not a trivial problem by any stretch of the imagination. Yet this is exactly the problem that the Connectivity Standards Alliance aims to address with the recently launched Matter protocol.

Note: Image credit Signify (p29)


PHILIPS
matter
hue

The Solution – Matter

The Connectivity Standards Alliance is a global organization of hundreds of companies creating, maintaining, and delivering open global standards for the Internet of Things (IoT), which brings together the entire smart home value chain, from silicon vendors, module and component providers, device manufacturers, smart home ecosystems, app developers, and retailers, who all buy into the same solution: every smart home device must work with each of the smart home ecosystems separately, as well as from one smart home ecosystem to another smart home ecosystem, irrespective of the underlying wireless connectivity protocol. When buying a smart home device, every consumer must know with confidence that their latest purchase will work with the devices and smart home systems already in their homes. This is the promise of Matter.

So how do we get there? The central idea of Matter is to reduce the need for device makers to build different versions of their products for different smart home ecosystems. If device makers no longer have to worry about, and spend development resources on, ensuring their devices can connect properly to different ecosystems, this would free them up to focus on innovation on behalf of their customers. Or, to put it in different words, lighting companies should focus on exciting their customers with compelling and great quality lighting experiences, and not on how their smart bulb connects to any of the smart home hubs. It allows device manufacturers to focus on value-added services and features.

Key to make this all possible in Matter is a feature called multi-admin, which allows consumers to control their smart devices from multiple ecosystem commissioning apps. Any Matter controller app is designed to pair to any and all Matter devices on the local network. You no longer need a separate, dedicated app for each of your devices or for each of your device vendors. In addition to that, controllers can also pair to devices that may have already been onboarded or commissioned in other ecosystem apps. In other words, the device is not locked-in to any of the ecosystems, as I can easily bring devices from one ecosystem to the other and vice versa. The walled gardens of closed ecosystems are broken down. Furthermore, if multiple users in the same home use different controller devices or different operating systems (e.g. I use Android on my mobile phone, my spouse uses iOS on her tablet, and my kids use the controller app on the TV), each will have the ability to for example change the color temperature or dimming level of the smart bulbs. Control of your smart bulbs, smart thermostat, smart locks, and smart window blinds becomes the smooth and ubiquitous experience that consumers should want from their smart home.

The Philips Hue Bridge will support Matter with a software update, meaning that your Hue lights and accessories automatically support Matter, too. Image credit Connectivity Standards Alliance.

Which Lighting Devices are Supported in Matter?

The first version of the Matter specification was launched by Connectivity Standards Alliance in the fall of 2022. The Matter certification program is currently open for the following lighting device types:

- Color Temperature Light
- Dimmable Light
- Dimmable Plug-in Unit
- Dimmer Switch
- Extended Color Light
- Functional Sub Lighting
- OnOff Light
- OnOff Light Switch

And while the Matter certification program only opened less than a year ago, today there is a broad range of products already certified by lighting and lighting controls companies both for the residential as well as professional markets. These Alliance member companies include Leedarson, Leviton, Nanoleaf, Orvibo, Sengled, Signify (Philips Hue and WiZ), Tuya, Uascent, and Zumtobel/Tridonic. In addition, there is a whole range of certified lighting modules and chipsets, certified by silicon providers (including Silicon Labs, NXP, Qorvo, Infineon, Espressif, and Ubisys). This is merely a selection of companies with Matter certified lighting products, and the list is growing rapidly. The full list can be found on the Certified Products webpage of the Connectivity Standards Alliance[2].

While there is a strong focus on smart lighting in the first release of the Matter specification, the list of supported device types continues to grow, as Alliance members from various market segments bring forward their use cases and add specification text, test cases and reference implementation code for the devices in their portfolios. Devices types, in addition to the aforementioned lighting and light control types, which are already part of Matter 1.0 include on/off plug-in unit, window covering, occupancy sensor, contact sensor, humidity sensor, pressure sensor, thermostat, door lock, and bridge devices. And even further device types we may expect in upcoming Matter releases, beyond 1.0, include robot vacuum cleaners, smoke and CO alarms, fans, air quality sensors and purifiers, and home appliances like washing machines, dish washers and refrigerators.

csa connectivity standards alliance

[2] https://csa-iot.org/csa-iot_products/

Where Are We On This Journey?

Evolving the Smart Home from cool gadget to ubiquitous infrastructure is a journey. Matter has been and continues to be an engineering project on a massive scale. The standard is backed by major ecosystem providers and device manufacturers through collaboration within the Connectivity Standards Alliance, with literally thousands of engineers from hundreds of member companies, over a 3-year period of spec development, to get version 1.0 out the door. Over a thousand Matter device certifications have been issued by the Alliance already today, and this number continues to grow. And while not all of these have been commercially released yet or are available on retailer shelves, this certification number should serve as a good leading indicator of what is to come.

This is indeed a journey. Matter has generated a lot of excitement in the market, and it will take time to implement this standard in the 100's of millions of smart home hubs and mobile devices already in the market. Fortunately, most if not all of these can be upgraded through over-the-air software updates. And once that process is completed, every household will have multiple Matter controllers already available to start building, expanding, and improving their smart home experience. Some of the first movers are on the market already, while many of the larger companies are in the process of transforming their portfolios and bringing that over to Matter. This can be realized by porting parts or all of the portfolio to Matter, or using bridging devices to for example Zigbee.

The Connectivity Standards Alliance itself, in the meantime, continues to develop extensions and functional updates to the specification, improving the tools, increasing the test coverage as well as test automation, improving the certification processes and policies, etc. The Alliance has been successfully doing this for decades and has a proven track record of reliably executing with speed and quality. As with any journey, you can join at any time, you do not have to wait until the final destination has been reached. There are significant benefits today, whether you are a consumer, device manufacturer, ecosystem provider or retailer.

Author: Musa UNMEHOPA is Head of Wireless Standards & Regulations at Signify (formerly Philips Lighting), where he is responsible for all wireless lighting control, visible light communication, application protocols, data protection and cybersecurity standardization and regulatory activities.

Summarizing the Journey

The recently launched Matter standard addresses a major coordination challenge across the entire Smart Home value chain, that has been an inhibitor to broader market adoption. Breaking down the walled gardens of smart home ecosystems allows device manufacturers to focus on innovation and value-added features, gives consumers choice and confidence, makes it easier for retailers to serve these consumers, and allows ecosystem platform providers to grow the collective pie. The Connectivity Standards Alliance is spearheading this journey to help evolve the Smart Home from gadget to ubiquitous infrastructure. Tremendous progress has been made already. Add to this the collaboration and commitment from all major players across the entire value chain and all major geographies, and it is clear that the ubiquitous smart home is not a question of "if", but a question of "when". If your company is not a member of the Connectivity Standards Alliance yet, then now is as good a time as any to join the journey. ■

Author: Musa UNMEHOPA
Musa Unmehopa is Head of Wireless Standards & Regulations at Signify (formerly Philips Lighting), where he is responsible for all wireless lighting control, visible light communication, application protocols, data protection and cybersecurity standardization and regulatory activities. His professional experience in technology and innovation spans 25+ years, and covers mobile communications, Internet, and lighting. At the start of this year, Musa was elected as the Chairman of the Board of Directors of the Connectivity Standards Alliance.
Prior to joining Signify and Philips in 2013, Musa held positions with Bell Labs, Lucent Technologies, and Alcatel-Lucent. Musa has held senior leadership roles in various standards bodies, trade organizations and industry consortia. These include chairman of the Technical Plenary of the Open Mobile Alliance, treasurer of the Zigbee Alliance, and Secretary General of the Zhaga Consortium. Furthermore, Musa served on the executive boards of the Zigbee Alliance, The Connected Lighting Alliance, the Emerge Alliance, and the Parlay Group. Author of two technology books, Musa has been an invited keynote speaker and panelist at various industry events. His publications include numerous papers in technical journals and conferences, as well as patents. Musa received a BSc. and MSc. degree in Computer Science from Twente University and MBA degrees from TIAS Business School in The Netherlands and University of Bradford School of Management in the UK.

Sustainability in Lighting Control Systems

DALI Alliance

While lighting has become much more efficient in recent years, it still represents around 15% of the world's electricity consumption and accounts for 5% of global greenhouse gas emissions[3]. This means that lighting should be a top priority when considering sustainability.

All organizations must reduce their energy consumption and carbon footprint, with legislation in many countries making this compulsory rather than just an optional goal. As well as reducing emissions, there's a win-win of cutting energy costs by improving the efficiency of lighting, as well as the benefits of a more sustainable, low-waste approach in terms of lower capital expenditure and replacement costs.

In this article we'll look at how smart, data-rich lighting control systems can help businesses achieve their sustainability goals. We'll also discuss the contribution of global standards such as the Digital Addressable Lighting Interface (DALI®).

Lighting Control Reduces Energy Usage

Sustainability in lighting starts with reducing energy consumption – thus cutting carbon emissions and reducing running costs.

Even with power-saving light sources such as LEDs, most commercial buildings have poor lighting efficiency because the lights are often on when the illuminated spaces are not in use. Lighting typically accounts for around 20 to 30% of total energy costs, depending upon the building type, so the potential savings are huge.

While even simple timers are better than relying on building occupants to switch off the lighting, a much more effective approach is to use an automated lighting control system. Enabled for example by DALI (**Figure 1**), the control system could use sensors to detect occupancy, movement and daylight levels. This adds to the gains achieved using LED light sources in combination with simple control techniques like switching and dimming.

PIR (passive infrared) sensors can detect occupancy in different parts of the building, and the system can then turn lights on and off in response – a large system may have thousands of such occupancy sensors. DALI sensors coupled with occupancy-based data analytics provide an extremely useful tool for facility managers who need to cut electricity consumption.

Another way to reduce energy consumption is with light-level sensors, which detect how much natural light is available in particular locations, so artificial lighting can be controlled in response. This 'daylight harvesting' method considers factors such as time of day, the sun's position in the sky and even the time of year.

Sensor-based lighting control can optimize both the brightness and color temperature of the artificial lighting and monitor environmental conditions to create a comfortable environment for building occupants. As well as promoting health and well-being, this can also help drive higher productivity in workplaces.

Overall, the more sophistication, more functions, and more intelligence in a lighting control system, the greater the energy savings. This requires suitable software that is intuitive and user-friendly, and straightforward controls and user interfaces that building occupants will be able to understand and use. DALI's role here is to standardize the functionality of input devices such as switches, sliders and push-button devices.

Figure 2 summarizes how DALI contributes to sustainable lighting systems.

Data Drives Results

The DALI protocol enables smart, data-rich networks in which the feedback and exchange of data is enabled by two-way digital communication. DALI control gear such as LED drivers routinely report their output levels, lamp failure information, emergency test data and other information to application controllers, the decision-making devices in a DALI system. DALI sensors and other input devices all provide valuable data that feeds into the lighting-control system and can trigger automated, real-time changes.

Several DALI data specifications have been developed to standardize the location and format of new types of data that can be stored in control gear. This data, which relates to light sources, luminaires and the drivers themselves, can be used for asset management, energy monitoring, diagnostics, predictive maintenance, and many other applications.

[3] Data from the US Department of Energy

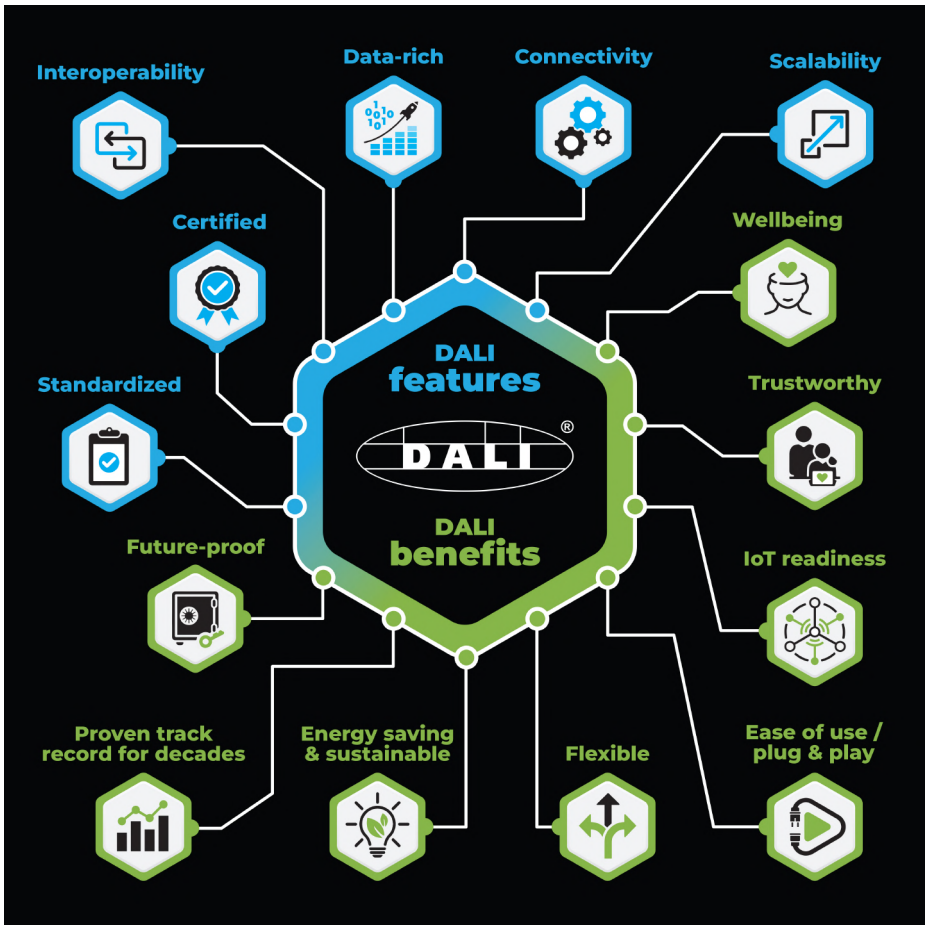


Figure 1: DALI features and benefits.

Figure 2: DALI can make important contributions to sustainable lighting systems via futureproofing, extended luminaire lifetimes and reduced energy usage.

To quantify the savings achieved through the effective use of a lighting-control system, we also must have effective monitoring of energy consumption—savings must be measured, not guessed. As well as measuring the overall energy usage, we need to get granular information of what's actually happening in specific areas of a building, or even inside individual luminaires – and DALI-compatible sensors can achieve this. Data of this kind can also prove crucial in applying for energy rebates.

Also, LED drivers can report a wide range of operational and diagnostics data, so the system can proactively alert the manager to any faults. Data analysis can predict when individual components or fixtures should be replaced, rather than employing a comprehensive replacement schedule after a fixed period of time. Significant savings can be achieved by employing a data-driven 'predictive maintenance' strategy, contributing to the overall sustainability of the lighting-control system.

Sustainable, Flexible and Future Proof

As well as reducing energy consumption, sustainability also includes factors such as reduced materials usage and recycling in line with the UN's Sustainable Development Goal 12: Responsible Consumption and Production. The main driving forces for sustainability are legislation, environmental issues, and social responsibility.

Another factor is the trend toward a 'circular economy', which has found broad support, including a policy and regulatory framework in the European Union (EU)[4]. Products that can be reused, refurbished, upgraded and recycled offer the potential for less waste, lower energy consumption and financial savings.

In the lighting industry, there is an increasing drive for replaceable components that extend the service life of luminaires. If suitable components are available – and if replacement is possible – then luminaires can be repaired, or upgraded with new and improved features and functions.

Here, the strength of DALI as a globally standardized protocol comes to the fore. The DALI-2 certification program, developed and maintained by the DALI Alliance, has created an ecosystem of interoperable products from multiple vendors. This ensures the long-term availability of com-

[4] https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/circular-economy-definition-importance-and-benefits

patible components, and avoids vendor lock-in and reliance on proprietary solutions that may not be supported in the future.

DALI-2 also provides backwards compatibility with earlier products. The DALI protocol has been around for decades, supported by all major players in the lighting industry. New extensions and certification programs (such as DALI-2, D4i and DALI+) are forward-looking and – crucially – standardized.

DALI is flexible and lends itself to future-proof designs that extend the useful life of a lighting control system. Changes to the design of a DALI system and how it is operated can often be dealt with by software reprogramming, rather than having to rewire or replace luminaires and other equipment. This could, for example, allow a building operator to easily change the layout of office spaces to accommodate new tenants.

Futureproofing is enabled at the luminaire level by the Zhaga-D4i connector system, which facilitates plug-and-play replacement of luminaire-mounted sensors and communication nodes. Zhaga-D4i combines the standardized mechanical interface from the Zhaga Consortium with the communication and power requirements specified by the DALI Alliance as part of the D4i certification program[5].

Zhaga-D4i certification has enabled an ecosystem of interoperable luminaires and control devices. This allows luminaire owners to easily update their fixtures, protect their investment, sustainably extend the life of the luminaire, and keep pace with fast-moving developments in digital networking and sensing technologies.

Look, No Wires

While wired systems provide network stability and reliable connectivity, there is growing interest in wireless capabilities, which should be considered in future-proofing any system.

With a wireless lighting control system, it's possible to position wireless control devices without having to run network cables (although power is still required). This can increase flexibility while also making it easier to scale up systems and add new devices. With no new cabling, labor and material costs are reduced, and there's less damage to the building.

[5] www.dali-alliance.org/d4i

Two approaches have been developed that combine the DALI protocol with wireless technology.

Firstly, the standardized gateways[6] approach enables wired DALI networks or D4i/DALI-2 luminaires to be incorporated into wireless ecosystems such as Zigbee or Bluetooth Mesh.

Then, the DALI+ approach enables DALI to be used over wireless and IP-based networks, thus increasing choice and flexibility. The DALI Alliance is developing certification programs for both the standardized gateways and DALI+ with Thread as the carrier[7].

There are some scenarios where a wired solution is preferred or required. In different circumstances, hybrid solutions may be desirable. DALI provides choice and keeps future options open by enabling wired and wireless networks to operate together. For example, wireless DALI+ networks can incorporate bridges that provide a link to a wired DALI network, with DALI used throughout as the communication language.

DALI+ over an IP-based carrier such as Thread also opens the possibility to integrate the lighting system with other functions via a building's IT infrastructure.

DALI in Action

Lighting control systems based on DALI have been adopted around the world – here are a few examples that were among the winners of the 2022 DALI Lighting Awards[8].

The winning project in the Industrial[9] category, submitted by Synapse Wireless, was the Uline Store C6 in Ontario, California, USA.

Figure 3: Uline Store C6, Synapse Wireless.

This indoor warehouse uses more than 4,000 Cree luminaires with D4i drivers, connected by wireless networked lighting controllers. DALI data enables the system to achieve energy rebates, meet strict energy codes, and provide alerts when the lights are not operating as designed. Light sensors enable daylight harvesting, making optimum use of the facility's 76 skylights. DALI control enables smooth dimming that maximizes comfort for employees.

[6] www.dali-alliance.org/wireless/gateways.html
[7] www.dali-alliance.org/daliplus
[8] www.dali-alliance.org/awards2022
[9] Industrial Category

In the Infrastructure[10] category, Delmatic was the winner for the Elizabeth Line, a new 118 km high-speed rail network in and around London, UK.

Figure 4: Elizabeth Line, Delmatic.

This is Europe's largest infrastructure project, lit entirely by LEDs and the complete installation uses DALI control to optimize efficiency, safety and aesthetics. DALI systems provide energy-efficient management and monitoring of normal and emergency lighting throughout the Elizabeth line stations, using more than 35,000 DALI assets, including luminaires, sensors, switches and controllers. Many DALI features were employed, including real-time monitoring and diagnostics, as well as occupancy and light-level sensors.

The Winner of the Residential[11] category was Shenzhen Sunricher Technology for the Taiziwan High-end Building in Shenzhen, PR China.

Figure 5: Taiziwan High-end Building, Shenzhen Sunricher Technology.

This large residential building, with 33 floors, uses DALI lighting control connected with the KNX building management system. More than 10,000 DALI drivers are used to achieve accurate, stable and smooth dimming without flicker. A key advantage of DALI was the ability to manually

[10] Infrastructure Category
[11] Residential Category

set the addresses in advance, thus saving the time required for on-site commissioning. DALI supports the use of preset scenes to automatically control light according to the functions of different areas, different times of the day, and outdoor light intensity.

In the Architecture & Entertainment[12] category, the winner was Tridonic for the Expo 2020 Entry Portals in Dubai, UAE.

Figure 6: Expo 2020 Entry Portals, Tridonic.

The portals are 10.5m wide, 21m tall and 30m in length. Recessed inground luminaires with customized optics provide a glare-free solution for pedestrians. Dynamic color mixing, delivered by DALI control, varies from warm white to an intense amber color at sunset, recreating the warmth of the natural Dubai light. DALI drivers enable the color temperature and brightness of the customized IP67 luminaires to be easily controlled by a single channel. In turn this reduces the amount of wiring and the complexity of the installation. DALI also helped the designers to meet the energy reporting and code requirements of the project.

The winner of the Healthcare and Education[13] category was Delmatic for the University College London Hospital.

Figure 7: University College London Hospital, Delmatic.

In this 11-floor building (of which 5 floors are below ground), DALI helps to minimise energy usage, and enhance sustainability and operational efficiency. Precise DALI dimming and scene-setting in response to daylighting and occupancy enables flexible lighting schemes in different areas of the hospital, while enhancing the comfort and wellbeing of patients and occupants. DALI contributed to the building receiving BREEAM Highly Commended certification, which is a challenge to attain in a highly-serviced healthcare building with energy-hungry medical equipment.

In the Outdoor[14] category, the winner was Signify for the lighting renewal project in Algeciras, Spain.

Figure 8: Lighting renewal project in Algeciras, Signify.

Zhaga-D4i luminaires from Philips are connected via an outdoor luminaire controller attached to the Zhaga-D4i socket. This allows the luminaires to transfer DALI data to the Interact City connected lighting system, enabling users to remotely manage, monitor, and control the city lights. The control system dynamically provides energy consumption data and asset information, enabled by data stored in the D4i LED drivers. The system is future-ready due to the interoperability provided by standardized DALI and Zhaga-D4i technology. Overall, the new system has reduced energy consumption by more than 50%.

The winner of the Workspaces[15] category was Bluebottle for the office space at 83 Pirie Street in Adelaide, Australia.

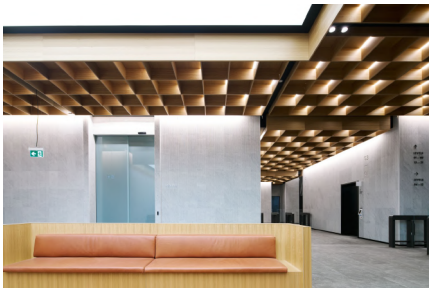


Figure 9: Office space at 83 Pirie Street in Adelaide, Bluebottle.

This 22-level office tower uses DALI throughout, for both illumination and emergency lighting, with components supplied by zencontrol. The DALI-2 application controllers ensure that DALI data is available to the BACNET building management system for monitoring and control. Integrated sensors are widely used, and DALI data provides analytics on the power consumption and savings from daylight harvesting and occupancy detection. DALI was chosen for its flexibility and ease of wiring. Bringing all the exit and emergency fittings onto the DALI bus along with the lights, motion sensors and switches greatly reduced the complexity of the wiring and offered substantial cost savings.

The Winner in the Retail and Hospitality[16] category is Delmatic for Battersea Power Station.

Figure 10: Battersea Power Station, Delmatic.

This iconic building in London has been transformed into a mixed-use destination. The precise dimming and scene-setting capabilities of the DALI-2 system enable flexible lighting layouts and scenes to be applied throughout the building, which contributes to a welcoming ambience and facilitates wayfinding. The DALI system is integrated with the DMX lighting that illuminates the building exterior. User interfaces and applications continuously monitor the complete lighting ecosystem and display real-time granular data and intelligent analytics on lighting performance. This includes DALI-2 emergency light monitoring and testing, as well as individual lamp and driver failure diagnostics.

Conclusion

To achieve sustainable lighting, a control system based on the DALI system can deliver the required reductions in energy usage, as well as ensuring a future-proof solution that minimizes unnecessary equipment replacement.

Taken together, this means that DALI can reduce total cost of ownership, while helping organizations to meet their sustainability goals. ■

[12] Architecture & Entertainment Category
[13] Healthcare & Education Category
[14] Outdoor Category
[15] Workspaces Category
[16] Retail and Hospitality Category

Re-Fit Lighting Solution: Backgrounds – Lighting Concept – Business Success

Peter HAUMER, Head of Technical Sales at Lumitech/Kiteo

Current challenges due to the ban on fluorescent tubes, exploding energy costs, and the demand for sustainability require integrative thinking. Solving this is an opportunity for both the lighting industry and the user.
Peter HAUMER, Head of Technical Sales at Lumitech/Kiteo, reveals why, besides energy efficiency, additional aspects are essential for professional Re-Fitting. The article explains the motivation and urgency of this topic and discusses the benefits that can be derived from the described linear solution for several applications.

KITEO is part of the Lumitech-group, a lighting solution provider from Austria, well known for its daylight-like lighting, based on the worldwide patented PI-LED technology from Lumitech.
Based on the expertise of >500 km linear LED lighting solutions per year, backgrounds and motivation, innovative technical solutions and lighting concepts, and business success for the brand-new sustainable Re-Fit LED solution that is already prosperous in the lighting market will be described.

www.kiteo.eu

Backgrounds

Placing T8 fluorescent lamps on the market was planned to be banned from September 2023. The latest amendments to the RoHS directives moved the end of the fluorescent tube a few days up: from August 25, 2023, T8 and T5 fluorescent lamps will be phased out. The RoHS [Restriction of the use of certain Hazardous Substances in electrical and electronic Equipment] defines, among other things, the handling of mercury-containing lamps. The ban refers to the production of corresponding lamps. It is a phasing-out of non-sustainable light sources.

The T8 and T5 lamps will be banned at the end of August 2023.

Furthermore, it is well known that, unfortunately, the current international upheavals also result in the dramatic challenge of partly skyrocketing energy costs. Following reliable long-term forecasts, they will stay significantly higher than they have been in the years prior. Incidentally, the forced replacement of fluorescent tubes with more efficient solutions is advantageous in this context. This requires, in general, an increase in the lighting solution efficiency significantly because of cost-considerations and also in terms of sustainability, because, last but not least, saving energy means a clear and robust contribution to lasting sustainability.

Conventional Previous Approach

The most common area of application for linear fluorescent tubes is rectangular or square luminaires, which are most frequently used. Very often, fluorescent tubes are replaced by LED tubes, which come characteristically from China. The advantages are: simple to exchange, housing preservation, and average energy saving, respectively, the beam angle and lifespan improvement.

But there are several drawbacks because this procedure has quite a lot of stumbling blocks:

- One financial issue is that typically the mere exchange of the light source is outside the scope of environmental subsidies.
- It is just as important to know that following the normative regulations and applicable standards, the light source exchange means an intervention in the luminaire and an evident technical change to the original arrangement.

Conformity to Standards

One has to be aware of the danger when converting the electrics of the light (so-called ´conversion´) that the *CE conformity expires*!

So in any case, with this, therefore, not-recommended procedure, a new CE-declaration of conformity, including the necessary tests, must be performed, and new type-labeling has to be made - not least because of changed performance specifications due to different new technical data and specifications like watts, etc. deviating from the original version. Not to mention any test marks, which also lose their validity. Responsible for taking care of this is the executive electrician / electrical installer, who carries out the exchange of the light source.

Safety

Moreover, further use or bridging old ballasts leads to potential sources of danger! Plastic covers and lamp sockets may turn yellow and become brittle, and tend to break. Avoidance of hazards means no reuse of old lamp sockets, such as e.g., when just putting in / inserting LED tubes.

Brandnew Innovative & Trusted Solution

Why is it called Re-Fit?

In this discussed context, very often, the term Retro-Fit is used. It means just the replacement of the light source. Re-Fit explicitly describes the solution using a new (linear) luminaire and is, in contrast to LED-Tubes, typically eligible for environmental subsidies.

The standards-compliant solution for this is a linear LED-Luminaire, tested and certified according to current regulations, including CE-marking, e.g., ENEC certification, etc. These meet the prevailing status of the standard.

Luminous Efficacy

Optimization of the electronic layout and, in particular, through the pioneering use of new phosphor technologies leading to ultimately specific spectrally optimized phosphor formulations (phosphors) as a means of the election have been identified.

Lighting Solution Efficiency

Increasing efficiency is not only achieved by increasing the efficacy (meaning Lumen per Watt ratio). Supplementarily, also light-direction is the additional means of choice. The typical light radiation of a fluorescent tube was 360°. So more than half of the light does not go in the ultimately useful direction! By the way, conventional LED tubes also have this kind of disadvantage. They typically have a 180° beam angle.

The Kiteo Re-Fit offers 120°, which is optimum for being used within an existing cuboid-shaped housing to avoid losing light unnecessarily. Directional radiation allows maximum utilization of the emitted light and, thus, of the electrical energy used.

So the way ´out of the tube´ is directed light instead of 360° or 180° light output – avoiding high levels of light scatter loss. Because finally, it is the useful lux-level that counts for the application!

Based on experience, energy savings of typically up to 70% (compared to fluorescent tubes) and typically up to 30% compared with conventional LED tubes are possible.

Interim summary: This can be achieved with noticeably lower energy consumption than previous conventional approaches and the same brightness.

The legitimate demand for the best light includes basics like high color rendition, glare reduction, and being flicker-free, as well as the optional dimming feature to be fulfilled. With this premium solution from Kiteo, these basic requirements are fully taken into account. Additional choices can be made regarding different color temperatures. So Kiteo Re-Fit is undoubtedly state-of-the-art in these respects, too. Besides the above-explained advantages, reduced maintenance costs due to a very long lifespan – 70,000 hours - must also be considered.

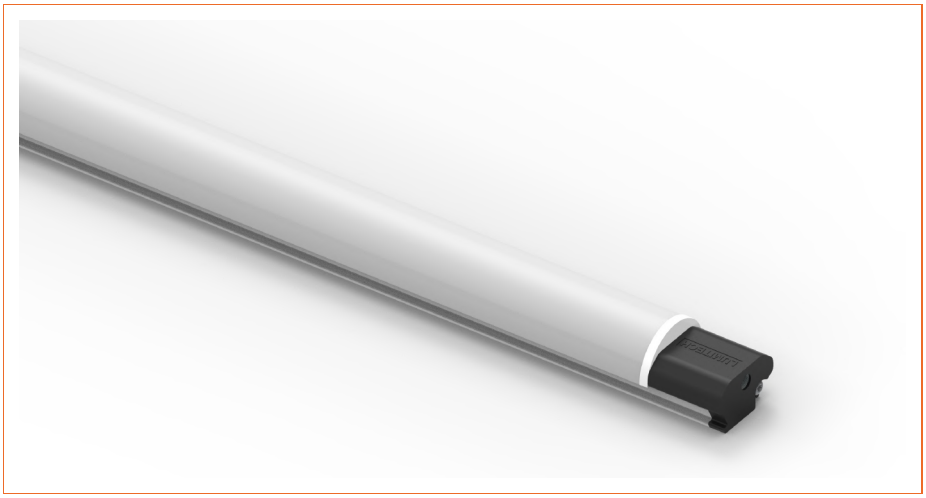


Figure 1: The new innovative linear LED luminaire from Lumitech/Kiteo (up to 180 lm/W; IP54) is the way ´out of the tube´.

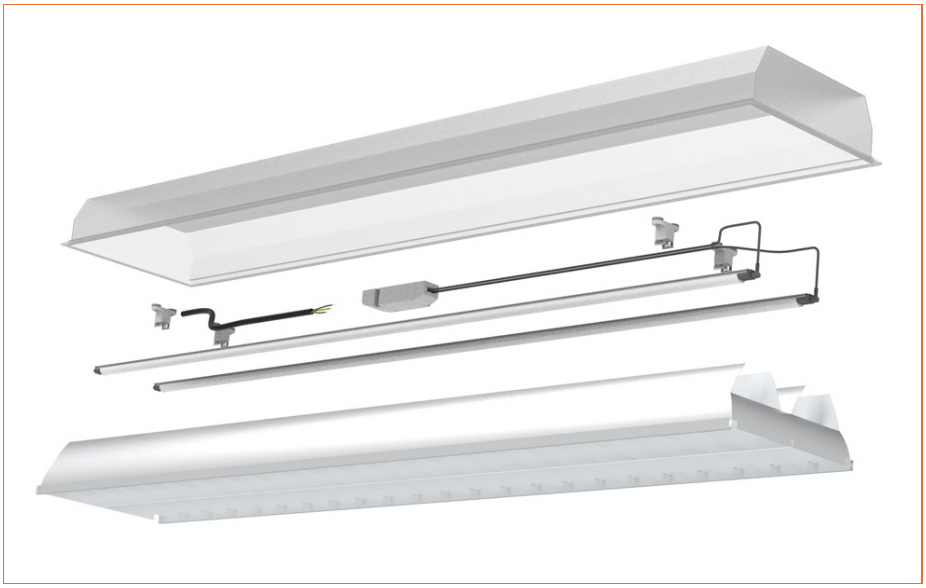


Figure 2: An example of a newly certified luminaire from Lumitech/Kiteo in existing housing.

Luminaire Structure

The needed time and, subsequently, the total costs for exchanging are dramatically reduced by the possibility of using magnetic clips for the fixing. In this case, no drilling or screwing is necessary. A modular toolbox consisting of perfectly matched assembly systems and plug connections (keyword: Plug&Play) facilitate a well-considered time-saving, Easy-to-Install solution.

This smart construction and mounting allow the reusability of the existing housings. Over and beyond in the case of flush-mounted fittings, no changes in the ceiling in terms of existing cut-outs have to be done. This is how cost-effective and thoughtful as well as practiced sustainability has to be.

The exhibition space of the Mercedes-Benz Museum in Stuttgart was retrofitted with the innovative, color-tuning Re-Fit lighting solution from Lumitech/Kiteo, eliminating the fluorescent tubes.
Photos: Oliver Roggenbuck | ROGGENBUCK PHOTODESIGN

Engineered in Austria - Made in Europe

Thanks to the production of the Kiteo Re-Fit Lighting Solution in Central Europe, short delivery times of a maximum of two to four weeks are typically feasible.

Holistic sustainability considering production and end-of-life: There is also a massive reduction of the carbon footprint in terms of production, not least because of the electricity mix used and also thanks to significantly shorter transport routes within Europe. All this leads to lower greenhouse gas emissions. This environmental advantage is effective and independent of the duty cycle and derives ecological benefit from the exchange. The use of mercury was one of many disadvantages of formerly available products. Therefore full sustainability has also already been considered in the R&D process of Kiteo Re-Fit. The described linear LED luminaires are developed and designed so that end-of-life challenges are well-considered and foresighted. Specifically, composite materials have been avoided due to modular construction enabling sorted recycling.

Carefree Full-service Package

Besides the necessities already mentioned, an essential requirement is that not just a replacement product is offered but a **holistic solution** for the specific application. This requires proximity to the customer and skills with lighting planning, etc. Project support during the entire project phase consisting of an upstream inventory, finding a lighting solution, and planning, which leads to a tailor-made offer that can serve as the perfect basis for an order, is fundamental. And, of course, the implementation and after-sales service plus optional commissioning support.

Best Practice

Amortization

As a rule of thumb, payback periods for such a Re-Fit project are typically, according to experience, around 6 months to 2 years, based on actual energy costs. And this remarkable short-term Return-On-Investment can be triggered more or less immediately because the Kiteo Re-Fit solution is available (in contrast to other energy-saving investments with very long delivery times). For business success, for example, one of Europe's biggest hospitals is already starting to exchange the existing fluorescent tubes with the above-described Re-Fit solution on a large scale.

"It was the most energy-efficient solution available on the market, enabling a very short amortization period."

CLIENT'S RESPONSIBLE PROJECT MANAGER

Conclusion

In a Nutshell

- New highest efficient and tested/certified luminaire in existing housing (tool-free mounting with magnetic clips)
- Easy-to-install
- Normative-compliance
- Reliability
- Avoidance-of-hazards
- Energy- & cost-saving
- Engineered in Austria
- Manufactured in Central Europe, resulting in short delivery times

"It's a sustainable solution since the housing can remain! The solution facilitates faster exchanges thanks to the shorter time required per fitting."

PETER HAUMER

From a larger perspective, the highly positive effects on the environment and society (national economies) are immediately noticeable. ■

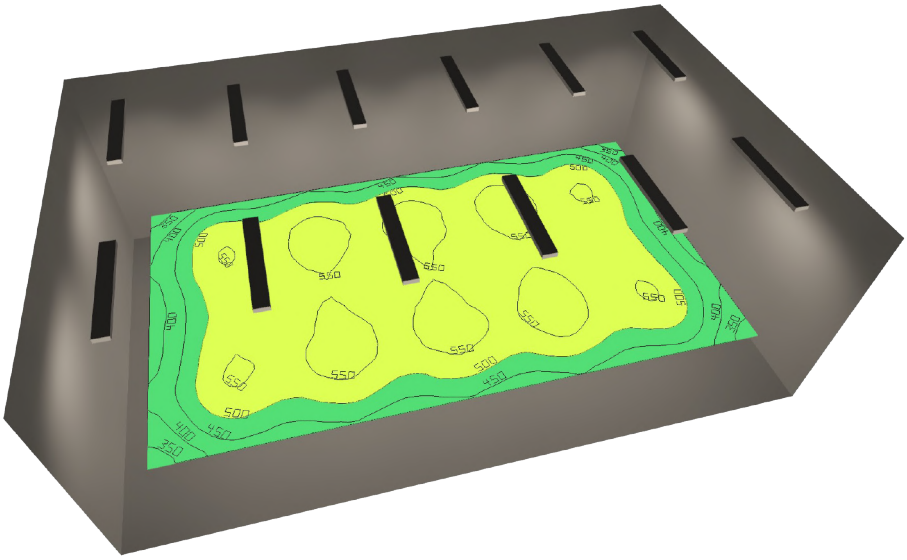


Figure 3: Proper light planning is an integral part of a professional Re-Fit project.

AUTHOR: Peter HAUMER, Head of Technical Sales at Lumitech/Kiteo

MEMBER OF LUMITECH GROUP

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Automotive LED Driver Power Conversion Topology Guide

Analog Devices

In many systems—including the myriad of regulators deployed in automotive power delivery systems—the design of power conversion regulators is often a difficult and complex task. This article aims to simplify the selection process by explaining the benefits, trade-offs, and applications for different switching topologies used for LED drivers. LEDs are unlike traditional electrical light producing filament or gas components. Utilizing specific semiconductor junctions, LED manufacturers can produce specific colors of light spanning the entire visible range—as well as IR and UV. In automotive applications, LEDs can increase the safety in both daylight and nighttime driving scenarios. Increased efficiency can extend battery life in electric vehicles, and multiple LEDs in a single system can eliminate single-component failures. Due to their versatility, LEDs offer the capability of being driven in many different ways. Since the output from LEDs is well-controlled light, LED loads are unlike traditional loads to a power system. LEDs only rely upon accurately regulated current, through the semiconductor junction, to produce light, where the relative voltages at the terminals to the system ground (or chassis in an automotive system) are unrelated. As a result, LED systems can take advantage of the different topologies offered by switching technologies.

How to Select the Correct Switching Topology for Automotive LED Systems

The choice of a particular switching topology in an automotive system is related to the complete system design; considerations should be taken into account for minimum input voltage, maximum string voltage, chassis return capability, shorted output capability, maximum input current, output/LED current, and PWM dimming.

Step-Down (Buck) Converters

Step-down (or buck) LED drivers regulate the current in an LED string from a voltage that is higher than the total LED string voltage. Buck LED drivers can be safely shorted to the system ground, making them both intrinsically safe. They can have the capability of chassis return (one wire for power), and they can easily be adapted to matrix or animation applications. **Figure 1** and an example schematic in **Figure 2** show basic system diagrams with the controller modulating the high-side switch for current control.

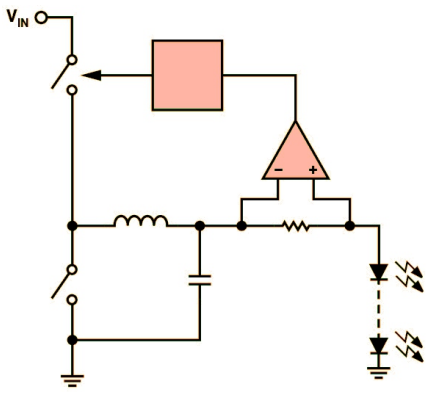


Figure 1: Buck converter.

Several critical features to look for in step-down LED drivers are fixed frequency operation, high efficiency through excellent switching control and low resistance switches, high accuracy throughout the analog dimming range, and, for excellent EMI, a properly designed spread spectrum frequency modulation.

Step-Up (Boost) Converters

Step-up (or boost) LED drivers regulate the current in an LED string from a voltage that is lower than the total LED string voltage. This is useful in many automotive systems, where many LEDs need to conduct in a single string. Typical 12 V automotive systems have operational ranges from 6 V to 18 V—requiring that the LED driver runs down to 6 V, providing large step-up ratios for the LEDs to remain illuminated. **Figure 3** and an example schematic in **Figure 4** show basic system diagrams with the controller modulating the low-side switch for current control.

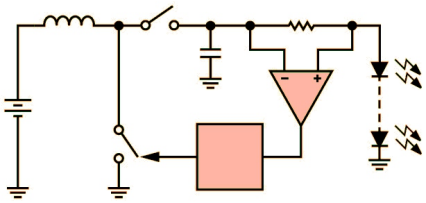
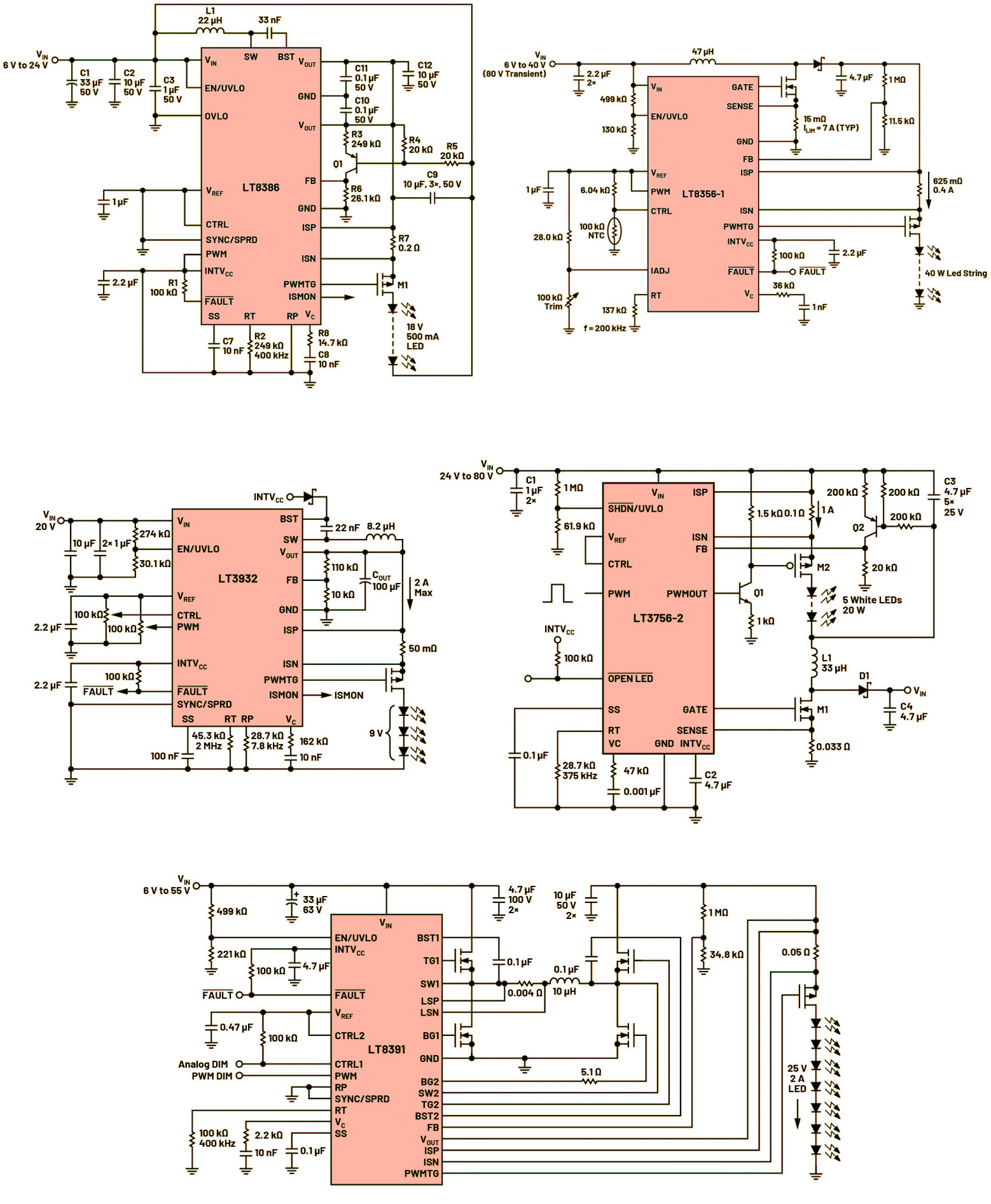


Figure 3: Boost converter.



LED Driver Schematics: **Figure 2, Figure 4, Figure 6, Figure 8, and Figure 10**. (top to bottom)

Boost-Buck Using a Boost Converter

Some step-up (or boost) LED drivers may be configured to return the LED cathode to the supply. This configuration is referred to as buck-boost. The total output voltage is VIN (VBATTERY), which is added to the total LED string voltage. The benefit of this topology is being able to drive an LED string that is higher, lower, or equal to the supply voltage. The limitations of this topology are only bounded by the converter—on the low end by the minimum supply voltage of the controller IC and on the high end by the controller IC's maximum output voltage (**Figure 5**, **Figure 6**).

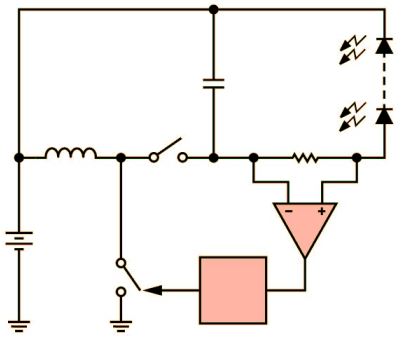


Figure 5: Buck-boost converter.

Buck Mode Using a Boost Converter

Some step-up (or boost) LED drivers may be configured to step-down from the supply (rather than ground referenced, as in a standard buck)—creating a buck-mode configuration. This configuration has the same limitations as a buck, where the total LED string voltage must be less than the input supply (**Figure 7**, **Figure 8**).

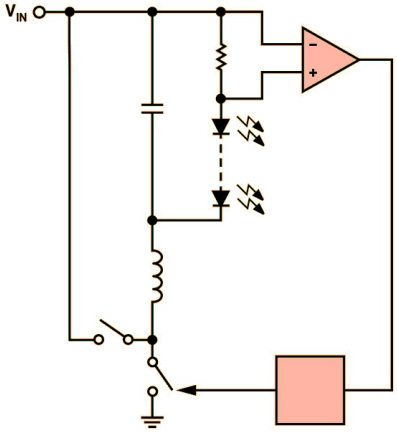


Figure 7: Buck-mode converter.

Buck-Boost Converter

Buck-boost LED drivers regulate LED current from a supply that is higher or lower than the total LED string voltage. The converter modulates the high-side switch connected to the input voltage in the step-down mode and the low-side on the output-side in step-up mode. This topology is the most complex but also the most flexible. VIN and VOUT ranges are only limited by the controller IC. This is a good choice for matrix applications (**Figure 9**, **Figure 10**).

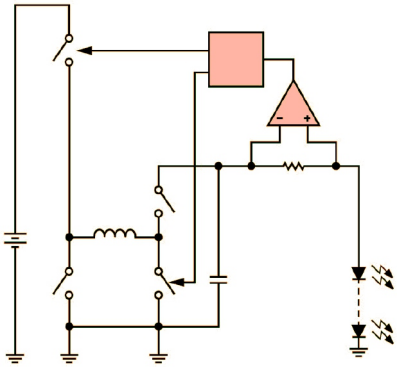


Figure 9: Buck-boost converter.

Conclusion

Automotive LED lighting systems can be driven with switching regulators in many different ways. Depending on the application, the selection of switching topology and configuration allows the lighting designer to create complete subsystems for the different lighting requirements throughout an automobile. Selecting the correct power conversion switching topology and configuration for the system optimizes requirements such as complexity, efficiency, EMI, and safety. ■

For additional information please visit https://www.analog.com.

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LpS Digital is the unique and first digital lighting conference and exhibition available to viewers 24 hours a day, 7 days a week. LpS Digital presents current, high-quality content about lighting technologies, design and applications, and acquaints the viewers with the latest trends in product developments and applications.

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Like the LED professional Symposium +Expo and Trends in Lighting Forum &Show that took place at the Festspielhaus in Bregenz/Austria every year since September, 2011, LpS Digital is meant to approach and support the complete value chain in the global lighting industry. When it comes to Technological Design, LpS Digital's goal is to provide Corporate Managment, Technical Management, R&D and Production/QM within the global lighting manufacturing industry with top notch technical knowhow, primarily on a component level. In terms of Lighting Design, LpS Digital will show best practice for Architects, Lighting Consultants, Electrical Consultants, Lighting Designers, Lighting OEMs, IT/IoT System Integrators and students. The editors focus on Human Centric Lighting, Connected Lighting, Smart Controls, Internet of Things, Light as a Service and much more.

Unique Global Reach in the Lighting Sector

VIRTUAL CONFERENCE
The authors of contributions accepted by the program management will be invited to give a presentation and, if appropriate, to write a qualified article. Each presentation will be announced to the industry and/or design channel contacts and followers immediately after publication.

VIRTUAL EXHIBITION
Virtual exhibitors have the possibility to present their products and/or services. The maximum length of the presentation is 20 minutes. Each product/service video is announced to the industry and/or design channel contacts and followers immediately after publication.

Lighting Industry & Technology Channel

With the Industry/Technology channel, over 30,000 contacts in the lighting sector are targeted and addressed. The opt-in databases are highly selective, highly qualified and address key persons in the respective channel.

- Magazine: 30,000
- Newsletter: 27,000
- Online: 30,000/month
- Twitter: 22,000
- LinkedIn: 11,700

Lighting Design Channel

With the Design channel, over 30,000 contacts in the lighting sector are targeted and addressed.

- Magazine: 30,000
- Newsletter: 15,000
- Online: 5,000/month
- LinkedIn: 4,600

Benefits for Conference Authors

- Global, highly-qualified target group
- Knowledge transfer at a high level
- Ideal platform for expanding the network

Benefits for Virtual Exhibitors

- Global, highly-qualified target group
- Immediate promotion of innovations and novelties
- Participation in the LpS/TiL Awards
- Highly efficient promotion at no risks

DALI Alliance

ZHAGA Consortium

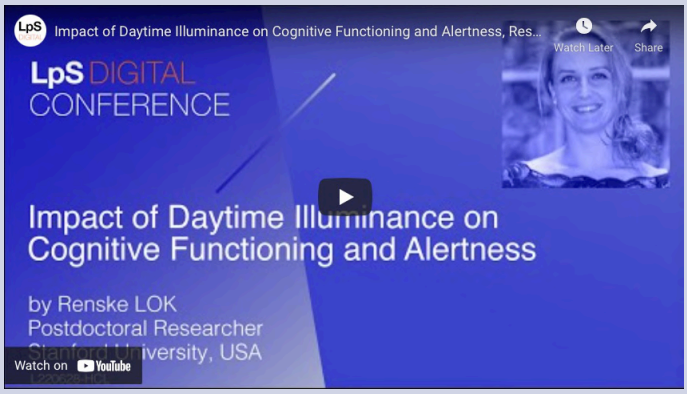
LIGHTINGEUROPE
THE VOICE OF THE LIGHTING INDUSTRY

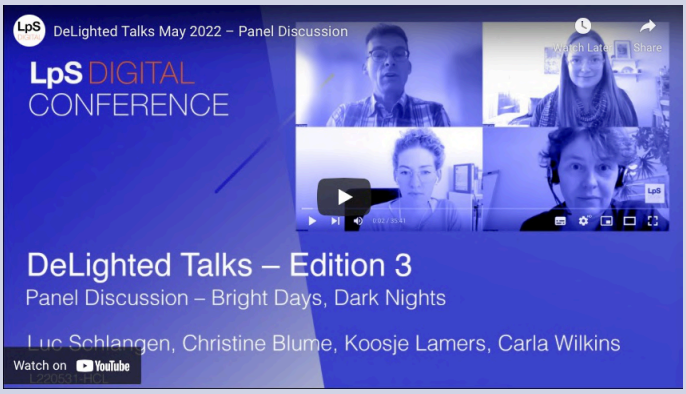
REPRO-LIGHT

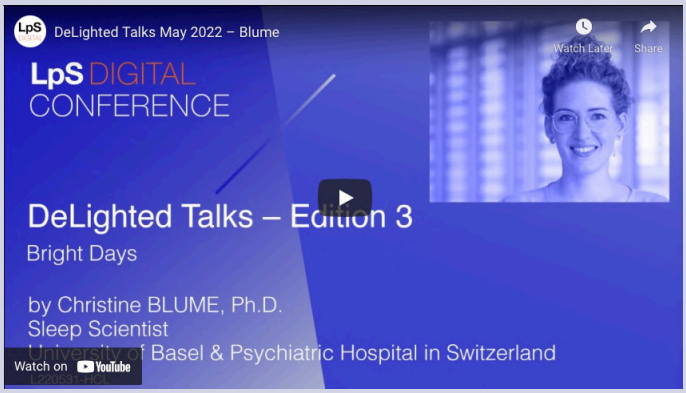
austria-architects.com
Profiles of Selected Architects

LpS DIGITAL

www.LpS-Digital.global







FINAL SYSTEMS PROVIDERS

This chapter lists final systems providers covering luminaires, controls, and services. The icons indicate the organization's type as manufacturer, distributor, service supplier, and country.

GLD registration on https://www.GLD.lighting

Manufacturers
Distributors
Service Providers

The highlighted subjects in APPLICATIONS, PRODUCTS, and SERVICES are areas of excellence.

AFRICA

SOUTH AFRICA

LEDVANCE

Emerald Park Block 2, 22
Reedbuck Crescent, Corporate
Park South Midrand
Gauteng, 1685
South Africa

ledvance.com

SIGNIFY

195 Main Road Martindale
Johannesburg, 2114
South Africa

signify.com

SWISS LED

Unit 82 - Northlands Deco
Park, Newmarket Road,
Randburg
Johannesburg, 2164
South Africa

swiss-led.com

AMERICAS

BRAZIL

INTERLIGHT ILUMINACAO

Rua Solange Aparecida Montan,
240
Itapevi - SP, 06610015
Brazil

+55 11 47899966
Send Email
interlight.com.br

APPLICATIONS Indoor | Outdoor
PRODUCTS Lamps

OMEGA LIGHT

Salgado de Castro, 265
Diadema - SP, 09920-690
Brazil

+ 55 11 50341233
Send Email
omegalight.com.br

APPLICATIONS Indoor | HCL | Outdoor

CANADA

BETA-CALCO

25 Kodiak Crescent
Toronto, M3J 3E5
Canada

+1 4162066872
Send Email
betacalco.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Automotive
PRODUCTS Luminaries | LEDs/OLEDs
SERVICES Production

POWER TUNING INSTITUTION

75 Sakr Qurish - Sheraton
El-Nozha, 4th Floor - 18
Heliopolis - Cairo, 11361
Egypt

+20222672075
Send Email
powertuningegypt.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries | Lamps | Networks | Drivers | Sensors/Interfaces
SERVICES Light as a Service | Design/Engineering | Testing

Brands: Legrand, CPelectronics, Rosco, Boluce, Schuch, Insta, Zemper, Formalighting, AcuityBrands

LUMENPULSE

1220 Marie-Victorin Blvd
Longueuil, J4G 2H9
Canada

+1 514-937-3003
Send Email
lumenpulse.com

APPLICATIONS Indoor | HCL | Outdoor | Street
PRODUCTS Luminaries

LUMINGEN TECHNOLOGIES

19358 96 Ave., Unit 155
Surrey, V4N 4C1
Canada

+1 604-371-4112
Send Email
lumingen.com

APPLICATIONS Indoor | Outdoor | Street | Automotive
PRODUCTS Luminaries | Light Modules | Networks | Sensors/Interfaces
SERVICES Light as a Service | Design/Engineering | Production

TMS LIGHTING

247A Summerlea Rd
Brampton, Ontario, L6T 4E1
Canada

+1 866-793-1174
Send Email
tmslighting.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs
SERVICES Design/Engineering | Production

CHILE

DECOSOLAR

Zenteno 1701, esquina Sargento
Aldea
Santiago, 8360892
Chile

+56 223729911
Send Email
decosolar.com

APPLICATIONS Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps | Light Modules
SERVICES Light as a Service

MEXICO

LIGHTENCO EN MEXICO

Bronce 153, Col. Morales
San Luis Potosi, 78180
Mexico

+52 4448251109
Send Email
lightenco.com.mx

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street
PRODUCTS Networks | Drivers
SERVICES Light as a Service

INDUSTRIAS RL

Mariano Escobedo 327 Los
Elizondo
Escobedo, N.L., 66050
Mexico

+52 81 8397 0655
Send Email
fiamma.com.mx

APPLICATIONS Outdoor | Street
PRODUCTS Luminaries
SERVICES Design/Engineering | Production

Brands: Fiamma, Signify, Osram, CREE, Samsung

PERU

LONTEC SAC

Calle Zaragoza 180 La Perla
Callao, Av. Javier Prado Oeste
340 Dpt. 1001
Lima, 15073
Peru

+5 1145 7072 9
lontec-sac.com

APPLICATIONS Indoor | Daylight
PRODUCTS Lamps | Light Modules | Networks | Controllers | Drivers | Sensors/Interfaces
SERVICES Light as a Service | Design/Engineering

USA

ALW

1035 22nd Avenue
Oakland, 94606
USA

+1 510 489 2530
Send Email
alwusa.com

AMERICAN ILLUMINATION

2421 W. 205th Street, Suite D103
Torrance, 90501
USA

+1 3102126550
Send Email
american-illumination.com

APPLICATIONS Indoor | Outdoor | Street | Horticulture
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Optics | Controllers | Cooling
SERVICES Design/Engineering | Production

ARCH LIGHTING

9176 Carlton Trail
Covington, 30014
USA

+1 6785387688
Send Email

APPLICATIONS Indoor | Daylight | HCL | Outdoor
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Optics | Controllers | Drivers | Sensors/Interfaces
SERVICES Production

Brands: Tuff Glo, Performance iN Lighting, Seven Rainbow Lighting

BREAKTHROUGH LIGHTING

20225 Lorenzana Dr
Woodland Hills, 91364
USA

800-882-8251
Send Email
breakthroughlighting.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Optics
SERVICES Light as a Service | Design/Engineering

ENERGY PLUS D.O.O.

Koprivnicka 19
Ludbreg, 42230
Hrvatska

+38542404024
Send Email
energyplus.hr

APPLICATIONS Outdoor | Street
PRODUCTS Luminaries | Lamps

CULTIUANA

13111 Brooks Dr Ste D, Baldwin Park, CA
Baldwin Park, 91706
USA

+1 6463 7996 97
Send Email
cultiuana.com

APPLICATIONS Indoor | Horticulture

DIALIGHT

1501 Route 34 South
Farmingdale, 07727
USA

+1 7327 5158 54
Send Email
dialight.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Phosphors, Adhesives & Coatings | Optics | Networks | Electronics | Controllers | Drivers | Mechanics | PCBs/Substrates | Cooling | Simulation Tools | Testing Equipment
SERVICES Design/Engineering | Production | Testing

ELELDLIGHTS

3615 Davisville Road
Hatboro, 19040
USA

+1 2158301200
Send Email
eledlights.com

APPLICATIONS Indoor | HCL | Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | PCBs/Substrates | Cooling | Production Equipment
SERVICES Design/Engineering | Production

ENERGY FOCUS

32000 Aurora Road
Solon, 44139
USA

+1 440 715-1280
Send Email
energyfocus.com

APPLICATIONS Indoor | HCL | Outdoor | Emergency
PRODUCTS Luminaries | Lamps | Optics | Networks | Electronics | Sensors/Interfaces | Mechanics | Cooling
SERVICES Light as a Service | Design/Engineering | Production | Testing

FEELUX

3000 Northwoods Parkway, Suite 165
Peachtree Corners, GA, 30071
USA

+1 678-668-7005
Send Email
feeluxlighting.com

FLEX LIGHTING SOLUTIONS

600 Shiloh Rd.
Plano, 75074
USA

+1 4692292564
Send Email
flexlightingsolutions.com

APPLICATIONS Indoor
PRODUCTS Luminaries | Networks
SERVICES Design/Engineering

Brands: Flex Lighting Solutions

FONROCHE LIGHTING AMERICA

220 Reservoir St. 19
Needham, 02494
USA

+1 339-225-4530
Send Email
fonrochesolarlighting.com

APPLICATIONS Outdoor | Street
PRODUCTS Luminaries | Networks
SERVICES Light as a Service

Brands: SmartLight Solar Lighting, Power365 Solar Lighting

FUTURE ENERGY SOLUTION

5400 NW 35th Ave.
Fort Lauderdale, 33309
USA

+1 9543310206
Send Email
feslighting.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | Networks | Electronics | Controllers | Sensors/Interfaces | PCBs/Substrates | Cooling | Connectors
SERVICES Light as a Service

Brands: FES

LAPA INDUSTRIES

1250A Wattley Way, Suite 100
McKinney, 75069
USA

+1 8008 3197 90
Send Email
lapaindustries.com

APPLICATIONS Indoor | Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries | Light Modules | Optics | Networks | Drivers | Sensors/Interfaces
SERVICES Design/Engineering | Production | Testing

LIGHTBOARD TECHNOLOGIES

696 Mendelssohn Ave. N.
Golden Valley, 55427
USA

+1 763 205 2412
Send Email
lightboardtech.com

SERVICES Design/Engineering | Production

LIGHTLAB INTERNATIONAL ALLENTOWN

905 Harrison Street, Suite 135
Allentown, 18103
USA

+1 484-273-0705
Send Email
LightLabAllentown.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Lamps | Light Modules | LEDs/OLEDs | Phosphors, Adhesives & Coatings | Optics | Networks | Electronics | Controllers | Drivers | Testing Equipment
SERVICES Light as a Service | Testing

LUXTRON SYSTEMS

Al Qusais
Dubai, 234010
USA

+971 4371 2740
Send Email
luxtron.net

APPLICATIONS Indoor | Daylight | HCL | Horticulture
PRODUCTS Luminaries | Light Modules | LEDs/OLEDs | Optics | Controllers | Drivers | Mechanics | Cooling | Connectors
SERVICES Design/Engineering | Production

Brands: A.A.G. Stucchi, Helvar, Xicato, ElectroTerminal, EUTRAC, Almeco, MechaTronix, Citizen, LEDiL

METEOR LIGHTING

1300 John Reed Court, Unit B
City of Industry, 91745
USA

+1 2132552060
Send Email
meteor-lighting.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency
PRODUCTS Luminaries

MODERN PLACE

3985 North W Street
Pensacola, 32505
USA

+1 800-912-9216
Send Email
modern.place

APPLICATIONS Indoor
PRODUCTS Luminaries | Lamps
SERVICES Production

NULEDS

6082 Corte delCedro
Carlsbad, 92011
USA

+1 7607075600
Send Email
nuleds.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency | Horticulture
PRODUCTS Luminaries | Lamps | Light Modules | Networks | Electronics | Controllers | Drivers | Sensors/Interfaces | PCBs/Substrates

SLP LIGHTING

1400 S. Old Highway 141
Fenton, 63026
USA

+1 636 660 8128
Send Email
slplighting.com

APPLICATIONS Indoor
SERVICES Design/Engineering | Testing

SORAA

6500 Kaiser Drive, Suite 110
Fremont, 94555
USA

+1 855 467 6722
Send Email
soraa.com

APPLICATIONS Indoor | HCL
PRODUCTS Luminaries | Lamps | Light Modules

STARLED

2059 E. Del Amo Blvd
Rancho Dominguez, 90502
USA

+1 310-603-0403
Send Email
starled.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Lamps | Drivers

Brands: Cree, Nichia

SYNAPSE WIRELESS

6723 Odyssey Drive NW
Huntsville, 35806
USA

6152936649
Send Email
synapsewireless.com

APPLICATIONS Indoor | Daylight | Outdoor | Street | Horticulture
PRODUCTS Networks | Sensors/Interfaces | Cooling
SERVICES Light as a Service | Design/Engineering | Testing

Brands: Synapse Wireless, SimplySnap, SNAP

TELELUMEN

PO Box 3163
Saratoga, 95070
USA

+1 408-242-9703
Send Email
telelumen.com

APPLICATIONS Indoor | HCL | Horticulture
PRODUCTS Luminaries
SERVICES Design/Engineering | Testing

VISIONAIRE LIGHTING

19645 Rancho Way, Rancho Dominguez
Rancho Dominguez, 90220
USA

+1 3105126480
Send Email
visionairelighting.com

APPLICATIONS Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries | Networks
SERVICES Design/Engineering

VODE

21684 8th Street E. Suite 700
Sonoma CA, 95476
USA

+1 7079969898
Send Email
vode.com

APPLICATIONS Indoor
PRODUCTS Luminaries

ASIA

CHINA & HONG KONG

ALITE

Building #7, Tongfucun Inudstrial Park ,Dalang North Road
Shenzhen, 518109
China

+86-755-2951 5851-806
aliteled.com

APPLICATIONS Indoor | Outdoor
PRODUCTS Lamps

EXC-LED

Onggang Blvd.No.11, Songgang St., Baoan
Shenzhen, 518100
China

+86 755 2941 2799
Send Email
exc-light.com

APPLICATIONS Outdoor
PRODUCTS Luminaries | Lamps | Light Modules | Networks | Electronics | Drivers
SERVICES Design/Engineering | Production | Testing

GUANGDONG YIBAI OPTOTECH

A403-1 Bldg1, Shajinheng Industrial Park, Jianghai Hightech Zone
Jiangmen, 529000
China

+86 1363 1786 201
Send Email
yboptotech.com

APPLICATIONS Indoor | Daylight | Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries | Lamps | Light Modules | Networks | Electronics | Controllers | Drivers

KCM ENGINEERING & MANAGEMENT CONSULTANT

Room 813C 8/F HK Industrial Centre,, Cheung Sha Wan
Hong Kong

+852-21164639
Send Email
kcmconsult.com.hk

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Lamps | Networks | Drivers
SERVICES Light as a Service

Brands: Philips, Osram, iLighting, Megamen

KINGLUMI

5F. Bldg 2, Nangang 3rd ind. Zone, Tangtou, Shiyan, Bao'an
Shenzhen, 518108
China

+86 755 2951 6789 Ext. 8020
Send Email
kinglumi.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Phosphors, Adhesives & Coatings | Optics | Networks | Electronics | Controllers | Drivers | Sensors/Interfaces | Mechanics | PCBs/Substrates | Cooling | Connectors | Simulation Tools | Testing Equipment | Production Equipment
SERVICES Light as a Service | Design/Engineering | Production | Testing

Brands: LEDGEAR, CAMETA, K&L, Annulight

LIGHT ENGINE

Unit 618, 6/F, Photonics Centre, 2 Science Park East Avenue, Hong Kong Science Park, Shatin, Hong Kong
Hong Kong, NA
Hong Kong

21442082
Send Email
lightengine-tech.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Controllers | Drivers | Sensors/Interfaces | PCBs/Substrates | Cooling | Connectors
SERVICES Design/Engineering | Production | Testing

Brands: cabLED, OPNOVA

ZEPLINN

10E, 76 Hung To Road, Kwun Tong, Kowloon
Hong Kong, 852
Hong Kong

+85 2252 5747 1
Send Email
zeplinn.com

APPLICATIONS Indoor | HCL | Outdoor
PRODUCTS Luminaries | Lamps | Light Modules | Optics | Networks | Drivers
SERVICES Design/Engineering | Production | Testing

ZHONGSHAN SHOULIANG TECHNOLOGY

4th Floor, 141 Dongxing Dong Lu,
Tongyi Industrial Park, Guzhen Town
Zhongshan City, 528400
China

+86 1996 6324 310
Send Email
sl-uvsanitizer.com

PRODUCTS **Luminaries**

INDIA

CANARA LIGHTING INDUSTRIES

Mulky-Kinnigoli Airport Road
Mangalore, 574 150
india

+91 824 2290618
Send Email
canaralighting.com

PRODUCTS **Luminaries** | **Controllers**

DHANASHREE ELECTRONICS

11 Pollock Street
Kolkata, 700001
India

+91 3340224022
Send Email
RashmiLighting.com

APPLICATIONS **Indoor** | **Daylight** | **HCL** | **Outdoor** | **Street** | **Emergency**
PRODUCTS **Lamps** | **Networks** | **Drivers**
SERVICES **Light as a Service**

Brands: RASHMI LED

HPL ELECTRIC & POWER

Other:

B-802, Iskon Elegance, Nr Hotel Crown Plaza, SG Highway
Ahmedabad, 380051
India

+91 7966168835
Send Email
hplindia.com
Vikram Raut

APPLICATIONS **Indoor** | **Daylight** | **HCL** | **Outdoor** | **Street**

KWIKLYTE LUMINAIRES

W508, 9th Street, C sector, Anna Nagar West extension
Chennai, 600101
India

+91 4426530294
Send Email
kwiklyte.com

APPLICATIONS **Indoor** | **HCL** | **Outdoor** | **Street** | **Emergency**
PRODUCTS **Lamps** | **Light Modules** | **LEDs/OLEDs** | **Optics** | **Controllers** | **Drivers** | **Sensors/Interfaces**
SERVICES **Light as a Service**

Brands: Kwiklyte, Osram, Philips, LEDLum

LUMILUX LED SYSTEM

29, Madhav Industrial Park, Nr. Garden City, Kosamdi
Ankleshwar, 393001
India

+919714976398
Send Email
lumilux.in

APPLICATIONS **Outdoor** | **Street** | **Automotive**
PRODUCTS **Light Modules** | **LEDs/OLEDs** | **Phosphors, Adhesives & Coatings** | **Optics** | **Networks** | **Controllers** | **Drivers** | **PCBs/Substrates** | **Cooling** | **Connectors** | **Simulation Tools** | **Testing Equipment** | **Production Equipment**
SERVICES **Light as a Service** | **Design/Engineering** | **Production** | **Testing**

IRAN

NOORSAFORM LIGHTING

Suite 1, No.1, 13th Street, Mir Emad St., Motahari Ave
Tehran, 1587776418
Iran

+98 2188 5445 59
Send Email
noorsaform.com

APPLICATIONS **Indoor** | **HCL** | **Outdoor** | **Emergency**
PRODUCTS **Luminaries** | **Light Modules** | **LEDs/OLEDs** | **Networks** | **Controllers** | **Drivers**
SERVICES **Light as a Service** | **Design/Engineering** | **Production**

Brands: Fenos, ERCO, Deltalight, Siteco, ,Awex, Eutrac, OSRAM

ISRAEL

FORONICA

Hameyasdim 8, Mazor
Mazor, 00000
Israel

+972 54 231 6509
Send Email
fotonica.io

APPLICATIONS **Indoor** | **Outdoor** | **Horticulture**
PRODUCTS **Lamps** | **Light Modules** | **LEDs/OLEDs** | **Optics** | **Networks** | **Electronics** | **Sensors/Interfaces**

Brands: EVA3, EVA3S, EVA2P

KOREA

ALTO

H Tower, 15 Beodeunaru-ro, Yeongdeungpo-gu
Seoul, 07253
Republic of Korea

alto.co.kr

FEELUX

624-8
Sukwoo-RI, Kwangjeok-Myun
Yangju-City, 11414
Republic of Korea

feelux.com

MALAYSIA

ELR GROUP

c-5-4, Southgate Commercial Centre, Jalan Dua, Off Jalan Chan Sow Lin
Kuala Lumpur
Malaysia

+60 327335677
Send Email
elr-group.com

APPLICATIONS **Indoor** | **Daylight** | **HCL** | **Outdoor**
PRODUCTS **Lamps** | **Light Modules** | **Controllers** | **Drivers**
SERVICES **Light as a Service** | **Design/Engineering**

Brands: Krobox

GRUNZELL

Landmark Tower, Jalan Ngee Heng, Level 17, Suite 17-04
Johor, 80000
Malaysia

+91 9003 3443 27
Send Email
grunzell.com

APPLICATIONS **Indoor** | **Outdoor**
PRODUCTS **Luminaries**
SERVICES **Light as a Service**

TAIWAN

ACOFUSION LIGHTING

15F, No.653, Bannan Rd., Chung-Ho Dist.
New Taipei City, 235
Taiwan

+88 6282267709
Send Email
acofusion.com

APPLICATIONS **Indoor** | **Outdoor**
PRODUCTS **Luminaries** | **Lamps** | **Light Modules** | **Networks** | **Controllers** | **Cooling**
SERVICES **Design/Engineering** | **Production**

Brands: Acofusion

LEOTEK

A: 18F, No. 392, Ruiguang Rd., Neihu District
Taipei City, 337
Taiwan

+886 2 87982888
Send Email
leotek.com

APPLICATIONS **Daylight** | **HCL** | **Outdoor** | **Street**
PRODUCTS **Luminaries** | **Lamps** | **Light Modules**

THAILAND

LIGMAN LIGHTING

2300 Rama 9 Rd, Suan Luang,
Suan Luang
Bangkok, 10250
Thailand

+66 2 321 8211
Send Email
ligman.com

APPLICATIONS **Indoor** | **HCL** | **Outdoor** | **Street**
PRODUCTS **Luminaries** | **Light Modules** | **Networks** | **Sensors/Interfaces**
SERVICES **Design/Engineering** | **Production** | **Testing**

WE-EF LIGHTING

57, Moo 5
Samutprakarn, 10540
Thailand

027389610
Send Email
we-ef.com

APPLICATIONS HCL | Outdoor | Street
PRODUCTS Luminaries
Brands: WE-EF

SAUDI ARABIA

PAN LIGHTING

Riyadh, Saudi Arabia
Riyadh, 11427
Saudi Arabia

+966112651230
Send Email
panlighting.com.sa

APPLICATIONS Indoor | Outdoor
PRODUCTS Luminaries | Light Modules | Simulation Tools

SINGAPORE

VOSSLOH-SCHWABE

No 33 Ubi Avenue 3, #06-72
Vertex Tower A
Singapore

+65 72757533
Send Email
vossloh-schwabe.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Lamps | Networks | Drivers
SERVICES Light as a Service
Brands: Panasonic

OCEANIA

ILLUMINATION PHYSICS

6/40 Springthorpe Boulevard
Macleod, 3085
Australia

+61 3 9455 0761
Send Email
illuminationphysics.com

APPLICATIONS Indoor | HCL | Outdoor
PRODUCTS Luminaries | LEDs/OLEDs | Optics | Networks | Electronics | Controllers | Drivers | Sensors/Interfaces | Cooling | Testing Equipment
SERVICES Design/Engineering | Testing

LPA LIGHTING AND ENERGY SOLUTIONS

16A Palmer Parade
Cremorne, 3121
Australia

+61 3 8416 1500
Send Email
lpalighting.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Controllers | Sensors/Interfaces
SERVICES Light as a Service | Design/Engineering | Production

Brands: Lightnet, Unilamp, Landa, PAN, Egoluce

LUMASCAPE

18 Brandl Street
Eight Mile Plains, QLD 4113
Australia

lumascape.com

PIERLITE

96-112 Gow Street
Padstow, NSW 2211
Australia

pierlite.com.au

REXEL

Level 1 Building B12, Julius Avenue
North Ryde, NSW 2113
Australia

rexel.com

SPOKE LIGHTING

PO BOX 2329 ASCOT
Ascot, 4009
Australia

+61 4587 8442 2
Send Email
spoke.net.au

APPLICATIONS Indoor | HCL | Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries | Light Modules | LEDs/OLEDs | Optics | Controllers | Drivers | Mechanics | Cooling | Simulation Tools
SERVICES Light as a Service | Design/Engineering | Production | Testing

Brands: VS LIGHTING, TRIDONIC, CREE, OSRAM, LEDIL

THORLUX LIGHTING

7-9 Melrose Court
Tullamarine, VIC 3043
Australia

thorlux.com

XENIAN

42 Manor Rd
Ingleside, 2101
Australia

+61 299708133
Send Email
xenian.com.au

APPLICATIONS Indoor | HCL | Outdoor
PRODUCTS Luminaries | Lamps | Light Modules | Optics | Networks | Controllers | Drivers | Sensors/Interfaces | Connectors

Brands: ColorKinetics, Atex, Alto, Ecosense, CLS, i-Led, Linealight, Light Projects, Litelab, Luci, lumisphere, Madrix, Moda Light, Projektleuctan, Regent, Soraa, Universal Fiber optic/UFO, Whitegoods

LIGHT PROJECT

Level1, 339 St Asaph Street
Christchurch, 8011
New Zealand

+64 2155 4406
lightproject.co.nz

LUMAX TECHNOLOGY

156 Main South Road, Sockburn
Christchurch, 8042
New Zealand

+64 2102661867
Send Email
lumaxtechnology.com

APPLICATIONS Indoor | Outdoor
PRODUCTS Luminaries | Drivers
SERVICES Light as a Service | Design/Engineering | Production

EUROPE

AUSTRIA

CONCEPTLICHT

Lastenstrasse 37
Götzis, 6840
Austria

+43 5523 64565 - 237
Send Email
conceptlicht.net

APPLICATIONS Indoor

Brands: Artemide, Flos, Nimbus, XAL, Zumtobel

EGLO LEUCHTEN

Heiligkreuz 22
Pill, 6163
Austria

+43 52 4269960
Send Email
eglo.com

APPLICATIONS Indoor | Outdoor
PRODUCTS Luminaries | Lamps

GLASS TECHNOLOGY

Czerninplatz 1
Vienna, 1020
Austria

+43 69912345776
Send Email
glasstechnology.net

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency | Automotive
PRODUCTS Light Modules

Brands: Lightglass brilliant, Lightglass HCL, Lightglass Rainbow

FIAI

Egerbach 48
Schwoich, 6334
Austria

+43 5372 219999
Send Email
isoled.shop

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | Networks | Controllers | Drivers | Sensors/Interfaces
SERVICES Light as a Service | Production | Testing

Brands: ISOLED

XAL

Auer-Welsbach-Gasse 36
Graz, 8055
Austria

+43 3163170
Send Email
xal.com

PRODUCTS Luminaries

ZUMTOBEL

Schweizerstrasse 30
Dornbirn, 6851
Austria

+43 5572 390-0
Send Email
zumtobel.com

APPLICATIONS Indoor | HCL | Outdoor | Street | Emergency
PRODUCTS Luminaries | Networks
SERVICES Light as a Service

BELGIUM

FENOS

Fazantenstrast 46
Evergem, 9940
Belgium

+32 9335 8149
Send Email
fenos.be

APPLICATIONS Indoor | HCL | Outdoor
PRODUCTS Luminaries | Light Modules
SERVICES Light as a Service | Design/Engineering | Production

CROATIA

FILIX

Stancija Pataj 52A
Pazin, 52000
Croatia

+38 5522 5532 5
Send Email
filixlighting.com
Ivica Jekic, BDM

APPLICATIONS Outdoor

LUMA ENERGY

Miramarska 24
Zagreb, 10000
Croatia

+385 1465 7705
lumaenergy.com

CZECH REPUBLIC

ROBE

Hazovice 2090
Roznov pod Radhostem, 757661
Czech Republic

+420 571751500
Send Email
robe.cz

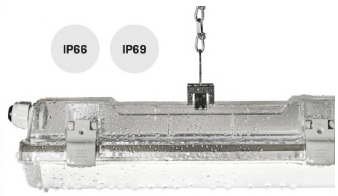
APPLICATIONS Indoor
PRODUCTS Luminaries

TREVOS

Nova Ves 34
Turnov, 51101
Czech Republic

+420 481 363 379
Send Email
trevos.cz

APPLICATIONS Indoor | Street
PRODUCTS Luminaries



TREVOS: NANOTTICA

trevos.eu

The nanooptical structure allows for more precise light distribution whilst maintaining high level performance across all other fundamental factors.

FRANCE

SMILED

8 Rue du Milieu
Montier en l'isle, 10200
France

+33 681364836
Send Email
SmiLED.fr

APPLICATIONS Indoor | HCL | Outdoor | Horticulture
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Optics | Networks | Controllers | Drivers | Cooling
SERVICES Design/Engineering | Production | Testing

Brands: Cree, Meanwell, Bridgelux, Mechatronix, LEDEVEN, Liite

UL INTERNATIONAL FRANCE

Espace Technologique
Batiment, Route de l'Orme des Merisiers
Saint Aubin, 91190
France

+33 1601 9880 0
Send Email
ul.com

PRODUCTS Luminaries | Light Modules
SERVICES Testing

GERMANY

ADOLF SCHUCH - LICHTTECHNISCHE SPEZIALFABRIK

Mainzer Strasse, Nr. 172
Worms, 67547
Germany

+49 6241-40910
Send Email
schuch.de

APPLICATIONS Indoor | Outdoor | Street | Emergency
PRODUCTS Luminaries

ALBERT LEUCHTEN

Hanns-Martin-Schleyer-Str. 1
Fröndenberg, 58739
Germany

+49 2373978110
Send Email
albert-leuchten.de

APPLICATIONS Indoor | HCL | Outdoor | Street
PRODUCTS Luminaries | Lamps
SERVICES Design/Engineering | Production

Brands: Albert Leuchten

ALURAYS LIGHTING TECHNOLOGY

Robert-Koch-Str. 1
Planegg, 82152
Germany

+49 89-82087068
Send Email
alurays.de

APPLICATIONS Indoor | Outdoor
PRODUCTS Luminaries
SERVICES Design/Engineering | Production

ANSORG

Pilgerstraße 11, Germany
Mülheim an der Ruhr, 45473
Germany

+49 2084 8461 241
Send Email
ansorg.com

APPLICATIONS Indoor | HCL | Emergency
PRODUCTS Luminaries | Lamps | Optics | Networks | Controllers | Drivers | Mechanics | Cooling | Production Equipment
SERVICES Light as a Service | Design/Engineering | Production | Testing

APOLLO AR

Friesenstr. 13
Wuppertal, 42107
Germany

+49 2022813767
Send Email
luminaire-ar.com

APPLICATIONS Indoor | Outdoor
PRODUCTS Simulation Tools

ARTROLUX

Albert-Einstein-Straße 6
Kempten, 87437
Germany

+49 831 74 60 96 48
Send Email
artrolux.de

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency
PRODUCTS Luminaries | Light Modules | Controllers
SERVICES Design/Engineering | Production

Brands: Sundrax

B+P LEUCHTEN

Holzener Strasse 56
Menden (Sauerland), 58708
Germany

+49 237363030
Send Email
bpleuchten.de

APPLICATIONS Indoor
PRODUCTS Lamps

BETALUMEN

Hebbelstr. 14 - 18
Dresden, 01157
Germany

+49 35147960960
Send Email
betalumen.de

APPLICATIONS Indoor | HCL | Outdoor | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Optics | Drivers
SERVICES Light as a Service | Design/Engineering | Production | Testing

DEUTSCHE LICHTMIETE

Im Kleigrund 14
Oldenburg (Oldb.), 26135
Germany

+49 441 209 373-0
Send Email
lichtmiete.de

APPLICATIONS Indoor | HCL | Outdoor | Emergency | Horticulture
PRODUCTS Luminaries | Networks | Sensors/Interfaces
SERVICES Light as a Service | Design/Engineering | Production | Testing

Brands: Concept Light, Holy Trinity, BEGA

DOT-SPOT

Industriestraße 1A
Schwarzenbruck, 90592
Germany

+49 91287222170
Send Email
dot-spot.de

APPLICATIONS Indoor | Outdoor | Horticulture
PRODUCTS Luminaries | Lamps | Networks | Drivers | Connectors
SERVICES Design/Engineering

ERCO

Brockhauser Weg 80-82
Lüdenscheid, 58507
Germany

+49 2351 551 0
Send Email
erco.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Networks
SERVICES Design/Engineering | Production

ERCO: JILLY LINEAR DOWNLIGHTS

erco.com

Flexible light for offices with a loft character: Jilly linear downlights for tracks.

GIP INNOVATION TOOLS

Hauptstraße 52
Siegen, 57074
Germany

+49 27138680300
Send Email
ligeo.de

APPLICATIONS Indoor | HCL
SERVICES Light as a Service

GROEBER MANNHEIM LICHTWERKE

Lübarser Str. 40-46
Berlin, 13435
Germany

+49 30 2359 5738 0
Send Email
groeber-mannheim.de

APPLICATIONS Indoor | Daylight | HCL | Outdoor
PRODUCTS Luminaries
SERVICES Design/Engineering | Production

Brands: Epstein

H+B BELEUCHTUNGSSYSTEME

Friedrich-Engels-Allee 240
Wuppertal, 42285
Germany

+49 202280820
Send Email
hundb.eu

APPLICATIONS Indoor | HCL | Outdoor | Street
PRODUCTS Luminaries | Lamps | Light Modules | Drivers

Brands: H+B, R7lighting, Tridonic, Tekno-Lit, Osram

HOLY TRINITY

Kleine Brüdergasse 5
Dresden, 01067
Germany

+49 3514045550
Send Email
holytrinity-lights.com

APPLICATIONS Indoor
PRODUCTS Lamps | Light Modules | LEDs/OLEDs

LED LINEAR

Pascalstrasse 9
Neukirchen-Vluyn, 47506
Germany

+49 284598462-0
Send Email
led-linear.com

APPLICATIONS Indoor | Outdoor
PRODUCTS Light Modules | LEDs/OLEDs | Optics | Controllers | Drivers | Connectors
SERVICES Light as a Service

Brands: VarioLED, XOOLUM, XOOMINAIRE

LEDISTO LEUCHTEN

Wingertstrasse 26
Frankfurt am Main, 60316
Germany

+49 69 944 131 90
Send Email
ledisto.de

APPLICATIONS Indoor | HCL | Outdoor
PRODUCTS Networks | Drivers

LEUCHTEN BUSCH

Holzener Str. 56
Menden (Sauerland), 58708
Germany

+49 237363039
Send Email
leuchten-busch.de

APPLICATIONS Indoor
PRODUCTS Lamps
SERVICES Light as a Service

LFF LICHT FORM FUNKTION LEUCHTEN

Bimericherstrasse 9
Solingen, 42653
Germany

+49 212 56052
Send Email
lff.de

APPLICATIONS Indoor | Outdoor
PRODUCTS Luminaries | Light Modules
SERVICES Design/Engineering | Production

LIGHTING ACCENTS

Hertzweg 4
Offenbach, 63071
Germany

+49 69-838305-0
Send Email
lightingaccents.com

APPLICATIONS Indoor | HCL | Outdoor
PRODUCTS Luminaries | Lamps | Light Modules | Networks
SERVICES Light as a Service | Design/Engineering | Production

LUX VELOCITAS

Rudolf-Diesel-Strasse 3
Günzburg, 89312
Germany

+49 8221-2079859
Send Email
lux-velocitas.com

APPLICATIONS Outdoor

REDULIGHT

Bockholtstrasse 102
Neuss, 41460
Germany

+49 211 93671150
Send Email
redulight.de

APPLICATIONS Indoor | Daylight | Outdoor | Street | Emergency
PRODUCTS Lamps | Drivers
SERVICES Light as a Service

SATTLER

Wilhelm-Zwickstraße 6
Jebenhausen, 73035
Germany

+49 7161 9201 9352
Send Email
sattler-lighting.com

APPLICATIONS Indoor | HCL | Emergency
PRODUCTS Luminaries
SERVICES Design/Engineering | Production

TEMPLED

Marmorwerkstrasse 52
Kiefersfelden, 83088
Germany

+49.8033.30257-10
Send Email
templed.de

APPLICATIONS Indoor | HCL | Outdoor
PRODUCTS Luminaries

THALER

Rosenbecker Str. 3
Berlin, 12689
Germany

+49 3075636002
Send Email
thaler-ag.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Phosphors, Adhesives & Coatings | Electronics | Drivers | Sensors/Interfaces | PCBs/Substrates | Cooling | Connectors | Simulation Tools | Testing Equipment | Production Equipment
SERVICES Design/Engineering | Testing

Brands: TRILL PAD Control Software for LED Lighting

VANORY

Alter Schlachthof 27
Karlsruhe, 76131
Germany

+49 72147035810
Send Email
vanory.com

APPLICATIONS Indoor | HCL
PRODUCTS Luminaries | Networks

VOLATILES LIGHTING

Nonnendammallee 44
Berlin, 13629
Germany

+49 3055 5734 46
Send Email
volatiles.lighting

APPLICATIONS Indoor | HCL
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs
SERVICES Design/Engineering

GREECE

INTERLIGHT

Ksenokratous 92
Athens, 12137
Greece

+30 2105731940
Send Email
interlight.gr.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Light Modules | LEDs/OLEDs | Controllers | Drivers
SERVICES Light as a Service | Design/Engineering | Production | Testing

Brands: OSRAM, PHILIPS, TRIDONIC, MEANWELL

HUNGARY

BERTON LIGHTING

Hoeromu utca 4
Budapest, 1211
Hungary

+36 14009212
Send Email
bertonlighting.hu

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps
SERVICES Light as a Service | Design/Engineering | Production | Testing

Brands: Luminaires: Berton; LEDs and Modules: Tridonic, Bridgelux, Lumileds, Nichia, Osram, Philips

ITALY

3F FILIPPI

Via del Savena 28
Pianoro, 40065
Italy

+39 051 652 9611
Send Email
3f-filippi.com

ARIANNA

Via dell'Industria, 14
Brugine (PD), 35020
Italy

+39 0497389920
Send Email
ariannaled.com

APPLICATIONS Outdoor | Street
PRODUCTS Luminaries

FORMALIGHTING

Via Europa 35/A
Pogliano Milanese (MI), 20010
Italy

+39 0293540300
Send Email
formalighting.com

FOSCARINI

Via delle industrie 27
Marcon (VE), 30020
Italy

+39 0415953811
Send Email
foscarini.com

APPLICATIONS Indoor | HCL | Outdoor | Emergency
PRODUCTS Luminaries

INNOVATION LED TRENTO

Via del Teroldego, 34
Mezzocorona, 38016
Italy

+39 3495487906
Send Email
innovationled-trento.com

APPLICATIONS Indoor | Emergency
PRODUCTS Luminaries | Lamps | Light Modules

Brands: Innovation Led Trento

KSCAPE

Via Paolina Romagnoli
17, Scarperia e san piero a sieve
Firenze, 50038
Italy

+39 055 8487 222
Send Email
kscapemergingsenses.com

APPLICATIONS Indoor | Daylight | HCL
PRODUCTS Luminaries | Networks | Simulation Tools
SERVICES Design/Engineering

NITEKO

Viale della Libertà, 8
Montemesola, 74020
Italy

+39 0995 6712 19
Send Email
niteko.com

APPLICATIONS Outdoor | Street | Horticulture
PRODUCTS Luminaries | Light Modules | LEDs/OLEDs | Optics
SERVICES Light as a Service | Design/Engineering | Production

Brands: Niteko illuminazione, Lorelux, Floraled Solar Spectrum

UNONOVESETTE

Via Goito, 18
Lissone, 20851
Italy

+39 039 6774597
Send Email
unonovesette.it

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency
PRODUCTS Luminaries | Light Modules | LEDs/OLEDs | Optics | Networks | Electronics | Controllers | Drivers | Sensors/Interfaces | Mechanics | PCBs/Substrates | Cooling | Connectors
SERVICES Design/Engineering | Production

Brands: unonovesette

ZUMTOBEL LIGHTING

Via G. Di Vittorio, 2
Cadriano di Granarolo
(BO), 40057
Italy

+39 345 291 1591
Send Email
zumtobel.com

PRODUCTS Luminaries

POLAND

NEONICA POLSKA

ul. Ossendowskiego 6A
Lodz, 93-228
Poland

+48 4263 0522 5
Send Email
neonica.eu

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Horticulture
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Drivers | Connectors

Brands: Neonica, OSRAM Optoelectronics, Cree LED, MeanWell

PLANTALUX

Konopnica 162
Konopnica, 21-030
Poland

+48 533916289
Send Email
plantalux.pl

APPLICATIONS Horticulture
PRODUCTS Luminaries | Lamps | Networks

SILVAIR

Jasnogorska 44
Krakow, 31-160
Poland

+48 12 376 95 98
Send Email
silvair.com

APPLICATIONS Daylight | HCL
PRODUCTS Light Modules | Networks | Electronics | Controllers | Sensors/Interfaces | Production Equipment
SERVICES Light as a Service | Design/Engineering | Testing

Brands: McWong, Murata, Fulham, Zumtobel, DG Light, Danlers, ERP Power

PORTUGAL

LIVINGLEDS

Rua Cidade De Ponta Delgada N144
Montijo, 2870-261
Portugal

+35 211211157
Send Email
livingleds.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor
PRODUCTS Luminaries
SERVICES Light as a Service

LLEDO

Rua do Entreposto Industrial, nr.3 1'DTO, Alfragide
Amadora, 2610-135
Portugal

+351 2147 1217 4
Send Email
lledogrupo.com

APPLICATIONS Indoor | HCL | Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries
SERVICES Light as a Service | Design/Engineering | Production

Brands: LLEDO, BEGA, ES-System, OMS, Carandini, INOTEC, ENIKA, ECOSENSE, Encapsulite, Stoanelighting, Lutron

SERBIA

TELLCO EUROPE

Djordja Rajkovica 19
Novi Sad, 21000
Serbia

+381 646167658
Send Email
tellco-europe.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Phosphors, Adhesives & Coatings | Optics | Networks | Electronics | Controllers | Drivers | Sensors/Interfaces | Mechanics | PCBs/Substrates | Cooling | Connectors | Simulation Tools | Testing Equipment | Production Equipment
SERVICES Light as a Service | Design/Engineering | Production | Testing

SPAIN

ARKOSLIGHT

Calle N – Pol. Ind. EL OLIVERAL
Ribarroja del Turia, 46394
Spain

+34 961 667 207
Send Email
arkoslight.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor
PRODUCTS Luminaries
SERVICES Light as a Service | Design/Engineering | Production

FUTURA TECHDYNAMICS

38 Rukmini Lakshmipathy Salai
Chennai 600008, Egmore
Chennai, 600008
India

044 42129977
Send Email
futuralights.com

APPLICATIONS Indoor | Outdoor | Street
PRODUCTS Luminaries | LEDs/OLEDs | Controllers | Drivers
SERVICES Design/Engineering | Testing

Brands: Futura

ILUMAX LED SOLUTIONS

Avda. de la Fama, 121-123
Cornellà de Llobregat, 08940
Spain

+34 931 275 634
Send Email
ilumax.es

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | Electronics | Drivers | Sensors/Interfaces | Connectors | Simulation Tools | Testing Equipment | Production Equipment
SERVICES Light as a Service | Production | Testing

Brands: ILUMAX

LUZ NEGRA

Carles Buhigues 13,, Pol. Ind. Can Castells, Canovelles
Barcelona, 08420
Spain

+34 938 402 598
Send Email
luznegra.net

APPLICATIONS Indoor
PRODUCTS Luminaries | Lamps | Light Modules | Optics | Drivers | Mechanics | PCBs/Substrates

SAGITARIO LIGHTING

Marqués de Sentmenat 22-24
Barcelona, 08014
Spain

+34 934911000 em
Send Email
sagitariolighting.com

APPLICATIONS Outdoor
PRODUCTS Luminaries

SIMON

Sant Pol de Mar 1
Barcelona, 08030
Spain

+34 6558 0038 8
Send Email
simon.es

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street

SWITZERLAND

ONLOG SUISSE

Via Locarno 25
Losone TI, 6616
Switzerland

+41 917456565
Send Email
onlux.ch

APPLICATIONS Indoor | Outdoor | Street
PRODUCTS Lamps | Networks | Drivers

Brands: onlux LED

SWEDEN

ANNELL LJUS OCH FORM AB

Gustafslundsvagen 131
Stockholm - Bromma, 16751
Sweden

+46 8 442 90 00
Send Email
annell.se

APPLICATIONS Indoor | HCL | Outdoor | Street
PRODUCTS Luminaries | Light Modules | LEDs/OLEDs | Sensors/Interfaces
SERVICES Light as a Service

Brands: AEC, ATP, Annell, Bega, Castaldi, Dark, Ledluks, Sattler, Wever&Ducré

TURKEY

HEPER LIGHTING

Malıkoy Baskent OSB 22, Cad No:2 Sincan
Ankara, 06730
Turkey

+90 312 267 54 30
Send Email
heperlighting.com

APPLICATIONS HCL | Outdoor | Street | Horticulture
PRODUCTS Luminaries | Light Modules | Optics | Electronics | Controllers
SERVICES Light as a Service | Design/Engineering | Production | Testing

UNITED KINGDOM

ARCHITECTURAL FX

25 Dowles Green, Longshot Lane
Bracknell, RG121RL
United Kingdom

+44 1344 291536
Send Email
afx.lighting

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Networks | Electronics | Controllers | Drivers
SERVICES Design/Engineering | Production | Testing

Brands: LED-Linear, ONE A, VICE Lighting, Linear FX

AURORA

Apex Park, 6 Little
Burrow, Burrowfields
Welwyn Garden City, AL7 4SW
United Kingdom

+44 (0) 1707 228 700
Send Email
auroralighting.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Emergency
PRODUCTS Luminaries | Lamps | Networks | Controllers | Drivers
SERVICES Light as a Service | Design/Engineering | Production | Testing

Brands: Electrical Wholesale, Projects and Smart Projects

BATHROOM DOWNLIGHTS UK

5 Dalmorton Road
Wallasey, CH45 1LE
United Kingdom

+44 333 443 2464
Send Email
bathroomdownlights.co.uk

APPLICATIONS Indoor | Outdoor
PRODUCTS Luminaries | Light Modules | LEDs/OLEDs

ECOALLY

Clyde House, Reform
Road, Berkshire
Maidenhead, SL68BY
United Kingdom

+44 1628 876076
Send Email
ecoally.co.uk

APPLICATIONS Indoor | Daylight | Outdoor | Street | Emergency
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Controllers | Drivers
SERVICES Light as a Service | Design/Engineering

EUROFINS HURSLEY

Trafalgar House, Trafalgar
Close,, Chandlers Ford,
Hampshire
EASTLEIGH, SO53 4BW
United Kingdom

+44 23 8027 1111
Send Email
emctesting.co.uk

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Lamps | Light Modules | Networks | Electronics | Controllers | Drivers | Testing Equipment
SERVICES Testing

GOODLIGHT

Unit 7, J4 Camberley, 15 Doman
Road
Camberley, Surrey, GU15 3LB
United Kingdom

+44 1276691230
Send Email
goodlight.co.uk

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Networks | Controllers | Drivers
SERVICES Light as a Service

Brands: Goodlight, Light Boss

LEVELLO

Unit 11, Offley Hoo Farm, Hoo
Lane
Great Offley, SG5 3ED
United Kingdom

+44 1462 768 220
Send Email
levello.com

APPLICATIONS Indoor | Emergency
PRODUCTS Luminaries | Light Modules | Networks | Sensors/Interfaces
SERVICES Production

Brands: Levello

LIGHT BOSS

Unit 7, J4 Camberley, 15 Doman
Road
Camberley, Surrey, GU15 3LB
United Kingdom

+44 1276691230
Send Email
lightboss.co.uk

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture | Automotive
PRODUCTS Luminaries | Lamps | Light Modules | LEDs/OLEDs | Networks | Controllers | Drivers
SERVICES Light as a Service

Brands: Light Boss, Goodlight

LIGHT PROJECTS

1St Floor Number 23, Jacob
Street
London, SE1 2BG
United Kingdom

+44 (0) 2072 3182 82
Send Email
Lightprojects.co.uk

APPLICATIONS Indoor | Outdoor
PRODUCTS Luminaries | Lamps | LEDs/OLEDs | Drivers

Brands: Hubbell Lighting,Tokistar, Wibre, Roblight.

OPTELMA LIGHTING

23 Bowling Green
Lane, Clerkenwell
London, EC1R 0BD
United Kingdom

+44 1235 553769
Send Email
optelma.com

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries | Lamps | Light Modules
SERVICES Design/Engineering | Production

Brands: Atelier Sedap, BEGA, dixheuresdix, Lightnet,

SILENT DESIGN

Unit 16, Lycroft Business Park
Southampton, SO32 2QQ
United Kingdom

01489 878 406
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APPLICATIONS Indoor | HCL | Outdoor | Emergency
PRODUCTS Networks
SERVICES Light as a Service

Brands: Philips, Tridonic, LEE

SWANN LIGHTING

Eco 1, Highcliffe Business
Park, The Cliff
Ingham, LN12WE
United Kingdom

+44 1522300202
Send Email
swannlighting.co.uk

APPLICATIONS Indoor | Daylight | HCL | Outdoor | Street | Emergency | Horticulture
PRODUCTS Luminaries | Drivers | Sensors/Interfaces
SERVICES Light as a Service | Design/Engineering | Production | Testing

Brands: Swann Lighting Limited, Iguzzini, LSI, SACO, Artemide, Philips, LITE, Osram, Tridonic, LITE

TM LIGHTING

Gallery, 7 Cubitt Street
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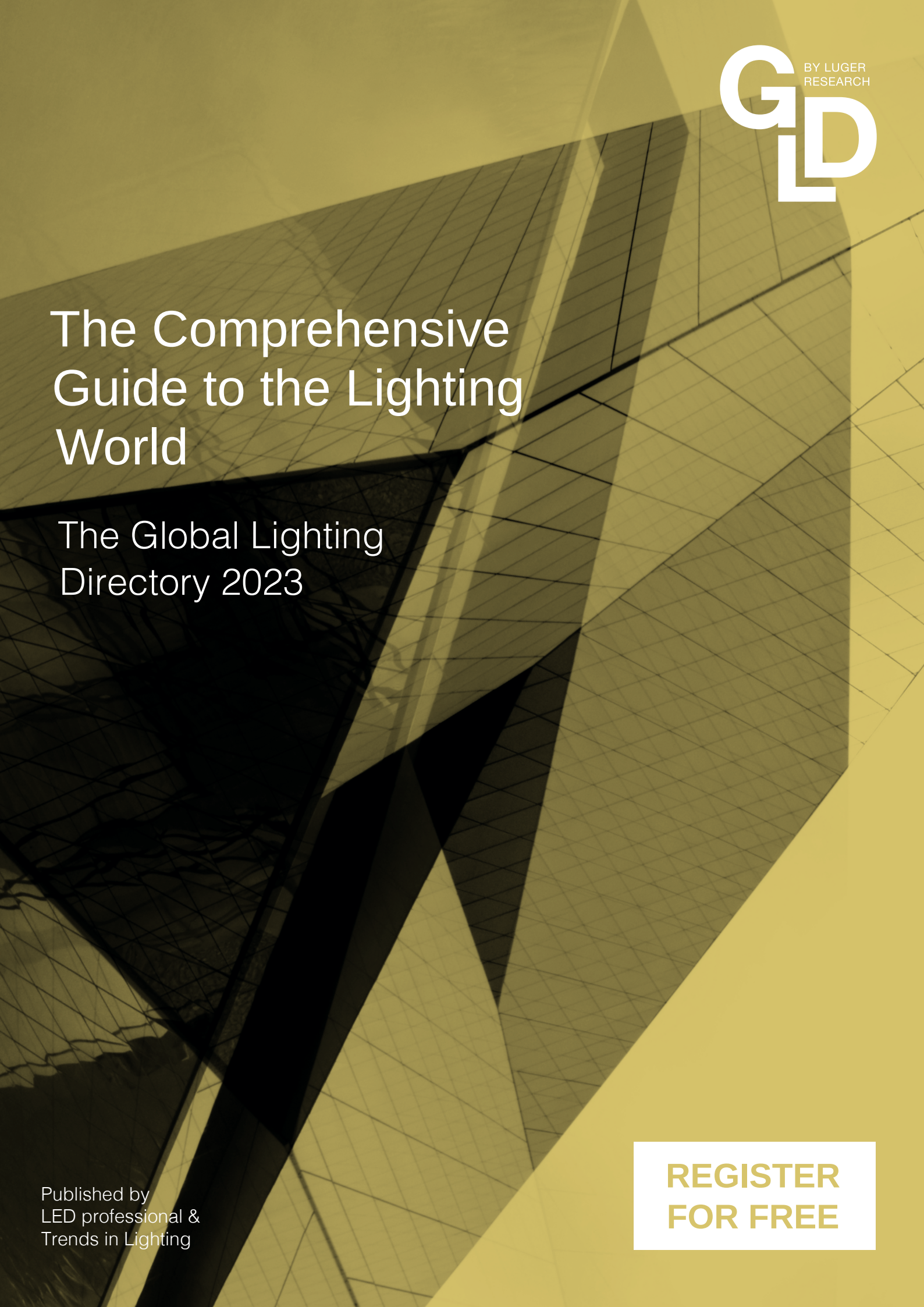
APPLICATIONS Indoor



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info@lugerresearch.com | www.lugerresearch.com
P +43 5572 394489 | F +43 5572 394489 90

Publisher
Siegfried Luger +43 699 1133 5570 s.luger@lugerresearch.com

Editors
Dr. Günther Sejkora +43 5572 394489 70 editors@led-professional.com

Theresa König +43 5572 394489 70 editors@led-professional.com

Elio A. Farina +43 5572 394489 70 editors@led-professional.com

Art & Design
Sarah Luger +43 680 2305 445 hallo@moments-of-aha.com

Account Manager
Christine Luger +43 699 1133 5520 c.luger@lugerresearch.com

China, Hong-Kong
Lolo Young +852 9792 2081 lolo@castintl.com

Germany
Armin Wezel +49 30526 891 92 armin@eurokom-media.de

India
Priyanka Rai +91 124 4787331 priyanka.rai@binarysemantics.com

South Korea
Jung-Won Suh +82 2 78 58222 sinsegi@sinsegimedia.info

Taiwan
Leon Chen +886 2 256 81 786-10 Jeon@jkmedia.com.tw

Benelux, France, Ireland, Scandinavia, UK
Zena Coupé +44 1923 85 25 37 zena@expomedia.biz

USA & Canada
Lesley Harmoning +1 218 686 6438 lesley@lhmandco.com

Jill Thibert +1 218 280 2821 jill@lhmandco.com

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