

INDIA'S FOREMOST MAGAZINE ON THE LIGHTING INDUSTRY

Lighting India ^{₹ 125}

Vol. 13 No. 5

September-October 2018



Lighting
Design for
Monuments



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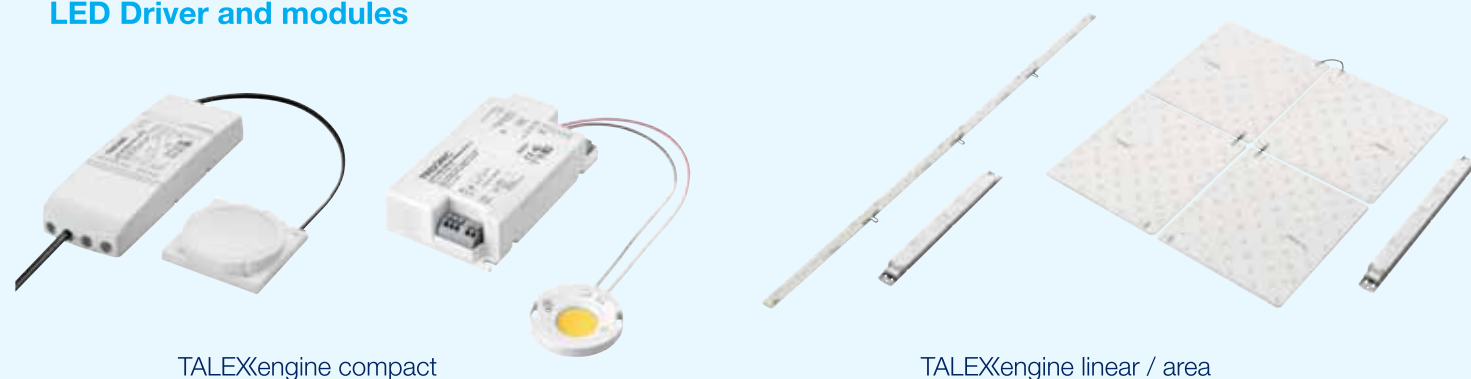
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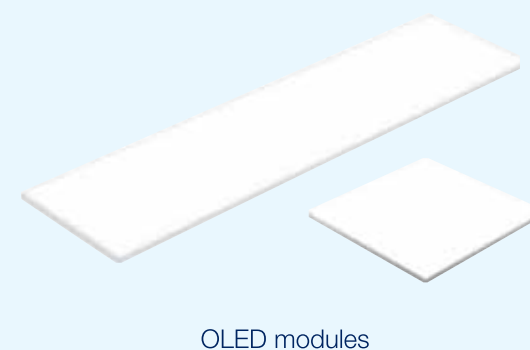
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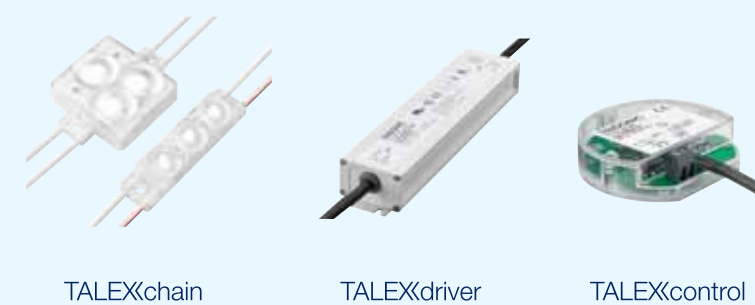
Electronic components



Controls



Signage



PUBLISHER'S LETTER



Lighting India wishes all its readers a very happy and safe Diwali. May this festival of lights bring with itself the luminance of a bright future.

The lighting industry in India facing the upward growth trajectory thanks to rapid urbanisation, a rising middle-class, increasing consumer spending, and most importantly the government's thrust on popularising energy-efficient LED lights. Of late, the country has crossed the 1 billion mark in LED lamps, about 12 million streetlights and more than 30 million downlights. Today, according to industry reports, more than 12 per cent of all LED lighting systems sold all over

the world is consumed by India alone. The demand for a smart, connected lifestyle and energy-efficient products is expected to drive the future growth.

Lighting is no longer just about heating a tungsten filament to illuminate a dark space. It has gone far beyond. Whether it is municipal street lighting, highway to sports and arena, from building facades to basement parking, one can now control the lighting operations by adding Ethernet-based control to lighting controllers. The advent of connected lighting is transforming how people use and interact with light. Further, the emergence of Big Data and the IoT (Internet of Things) are going to add much more intelligence into lighting systems. This time, we bring you an exclusive analysis on the power of connected lighting. Hope you'll enjoy reading it.

In October, New Delhi witnessed the major international lighting exhibition Light India 2018. The show saw a record number of visitors, and even more exhibitors. Over 193 exhibitors from India, China, Hong Kong and the UAE, brought an almost endless variety of new smart and intelligent lighting products which enthralled visitors from all over the world.

Again, in December, the lighting industry extravaganza – LED Expo 2018 – will take place in Noida near Delhi. Many major LED and allied industry players from across the globe will come together to showcase smart and tech-ready transformation under one roof. Lighting India, being the media partner of this mega event, will be present there to disseminate useful and effective information to a larger target audience. We are looking forward to see you there.

Till then, happy reading!

Do send in your comments to me at miyer@charypublications.in

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Single Issue: ₹ 125 / Annual Subscription: ₹ 750

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Printed, Published and owned by Mahadevan Iyer from 906, The Corporate Park, Plot 14 & 15, Sector 18, Vashi, Navi Mumbai 400703 and Printed at Print Tech., C-18, Royal Indl Estate, Naigaum Cross Road, Wadala, Mumbai - 400 031. Editor: Mahadevan Iyer





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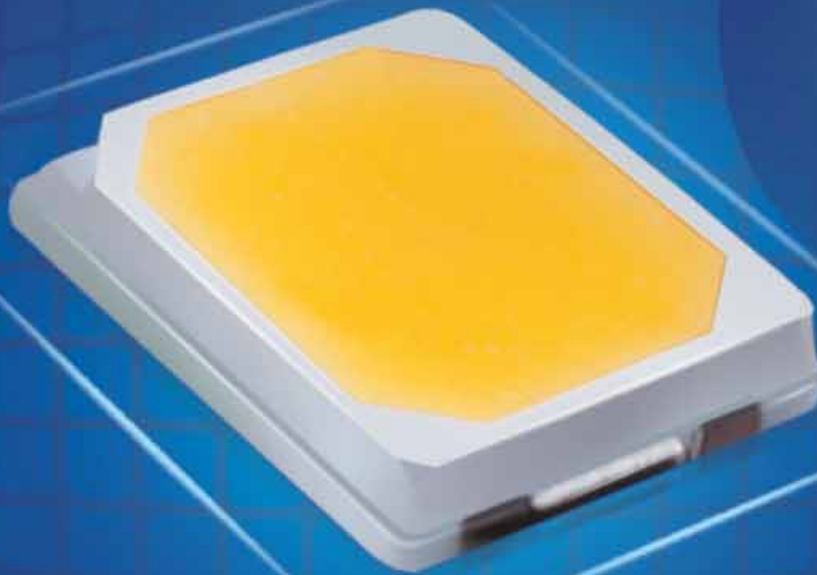
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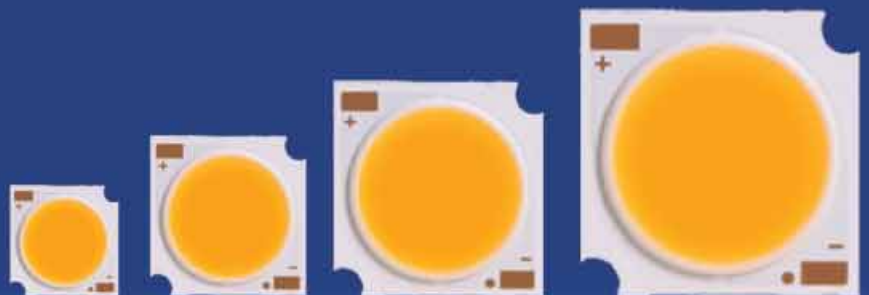
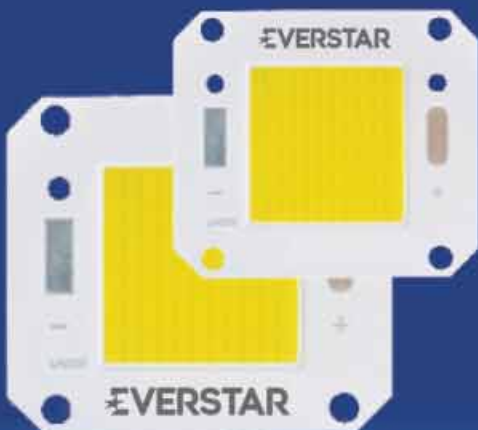


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ABB joins new partnership programme with Signify



Smart home technology major, ABB, announced its new partnership with Signify (formerly known as Philips Lighting) by unveiling a new range of smarter light switches at the IFA trade show in Berlin.

Aimed at encouraging companies to develop devices, applications and systems that interact with its leading smart lighting ecosystem Philips Hue, the Friends of Hue program has attracted many of the market's leading technology

providers including Amazon, Apple and Google. ABB's new range of Friends of Hue smart light switches will integrate seamlessly with the Philips Hue lighting system via the Hue bridge. This allows users to set up their light switch in the Philips Hue app and control and personalize home lighting and ambience via an ABB Friends of Hue switch.

The new ABB switches can turn lights on and off, dim specific bulbs and recall stored light presets. A Friends of Hue-specific energy harvesting module is due to be integrated in to the ABB ranges carat, solo, Busch-axcent and future linear.

The new Friends of Hue light switches from ABB will be available starting first quarter of 2019.

Anolis and ArKaos announce partnership



Architectural LED lighting manufacturer Anolis and real-time visual processing technology provider ArKaos announced a collaboration which will see the two well-known brands working together

on several future product developments. This is expected to result in huge benefits to lighting and media designers and concept agencies using ArKaos and Anolis.

Anolis's LED lighting, pixel-based fixtures and other hardware will have ArKaos's newly launched Cloud-based communications protocol An-Ki embedded, meaning that the growing trend for video-mapped content being run through LED 'media' installations can be maintained remotely from anywhere in the world, thanks to the ArKaos Cloud.

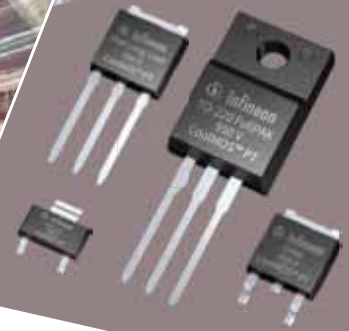
"This will add huge value to installation designers working in all fields" commented ArKaos' MD Agnes Wojewoda.

Fulham Expands DC Retrofit Engines Line

Fulham Co., Inc., a supplier of lighting components and electronics for commercial and specialty applications, has released a comprehensive new line of DC Retrofit Engines as part of its new line of Vizion LED DC Retrofit Kits Engines. Available in rectangular and round form factors, the new Vizion DC Retrofit Engines deliver lower power consumption and higher efficacy.

The new DC Retrofit Engines are offered with 0-10V dimming (100-10 percent) and universal voltage (120-277V) Class 2 output. They are packaged in six configurations, including four retrofit kits (9W/1400 lm, 13W/2115 lm, 20W/2820 lm, and 28W/4015 lm output) and two 4x7-inch rectangular units (9W/1400 lm and 20W/2820 lm output). These Vizion DC Retrofit Engines are suitable for retrofitting wall and ceiling mounted luminaires with or without plastic or glass lenses. In fact, they can be used for most lighting installations that call for a dimmable, preassembled driver and module in a compact form factor.





950 V CoolMOS™ P7 SJ MOSFET

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Designed to meet the growing consumer needs in the high voltage MOSFETs arena, the new 950 V CoolMOS™ P7 focuses on lighting and the low-power SMPS market. Target applications range from lighting, smart meter, mobile phone charger, and notebook adaptor, to AUX power supply and industrial SMPS. Offering 50 V more blocking voltage than its predecessor 900 V CoolMOS™ C3, the new 950 V CoolMOS™ P7 series delivers outstanding performance in terms of efficiency, thermal behavior and ease-of-use.



Infineon offers two evaluation boards for thorough testing. Plug-and-play at 90VAC in a 40 W adapter reference design, featuring the snubberless concept, demonstrates excellent efficiency gains of up to 0.2% and lower MOSFET temperature of up to 5.2°C compared to similar competitor technology.

The 950 V CoolMOS™ P7 comes in TO-220 FullPAK, TO-251 IPAK LL, TO-252 DPAK, and SOT-223 packages – allowing for changes from a THD to an SMD device.

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- › Easy to drive and to design-in
- › Better production yield by reducing ESD related failures
- › Less production issues and reduced field returns

HPL exhibits its innovative lighting solutions at Light India 2018

HPL Electric & Power Ltd displayed its entire lighting range at the Light India 2018 exhibition, covering consumer, lighting electronic drivers, commercial and industrial and outdoor lighting along with the new product innovations.

Speaking on the company's participation at the exhibition, Gautam Seth, Joint Managing Director, HPL Electric & Power Ltd said, "Light India 2018 being the most comprehensive exhibition for the international and domestic lighting manufacturer, is a great opportunity for us to display our speciality lighting range and to connect with the right stakeholders. This year, along with our existing range of smart lighting solutions like CCMS technology for streetlight,



Mobile operated LED lamps, IR censored based lighting panel for commercial segment, we are also introducing our new range of consumer products Spark LED panel and architectural beautification LED range. As a company, we look forward to such platforms that provide an opportunity to highlight the

new and energy efficient product offerings."

Light India 2018 brought together the major players in the industry to showcase their latest technologies and innovations thus providing insights about the fastest and most rapidly emerging trends in the lighting industry.

Surya Roshni bags order of Rs 50.34 cr from EESL

Lighting manufacturer Surya Roshni announced that the company has bagged an order worth Rs 50.34 crore from Energy Efficiency Services Limited (EESL).

The order is related to the design, manufacture, testing, supply and warranty of LED street lights and other related works to Gram Panchayats in Andhra Pradesh.

The order has been granted under SLNP (Street Light National Program) through competitive e-bidding, Surya Roshni informed BSE in a written statement.

The SLNP was launched by the Prime Minister Narendra Modi on January 5, 2015, and it aims to replace India's 14 million conventional street lights in India with Smart LED variants by 2019. A web-based monitoring system enables remote lighting operations and additional operational savings.

Orange Plus LED extends its lighting range

Orange Plus expands its LED portfolio with 2x2 LED working lights, which brings efficient and lower power consumption with glare free lighting.

With a thickness, lights are designed it adds a touch of efficacy. A no screw installation, the amalgamation of aesthetics.



less than 50mm the to please the eyes as luxury with high model with an easy product is the perfect technology and

Powered by 100 lumens per wattage the ultra-bright working light, features different light combinations with high brightness LED that brings uniform light distribution even in high ceiling areas. With long life of LEDs over 50,000 burning hours the light does not contain mercury, ensures zero maintenance, no UV and IR radiation. The environment-friendly panel consumes low energy and produces low running temperature.

Designed exclusively for the offices, arenas, showrooms and art galleries the lights, are compliant to formal set ups, adding a touch of elegance to every room.

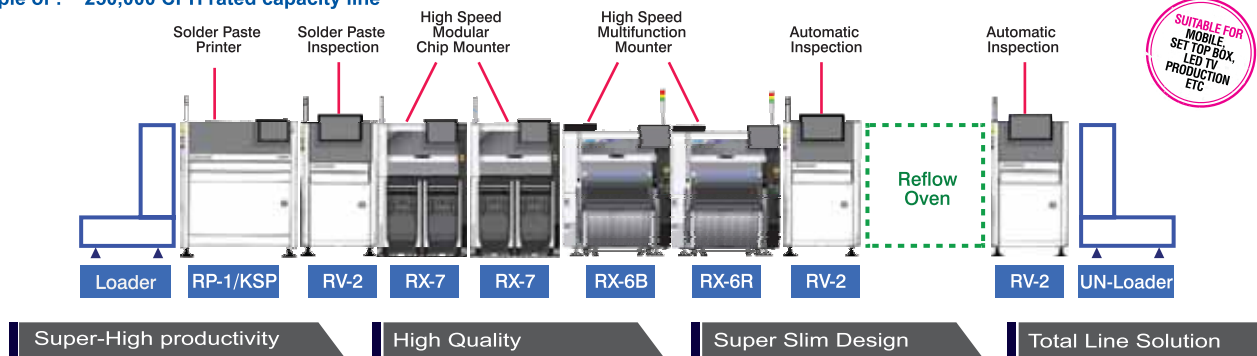
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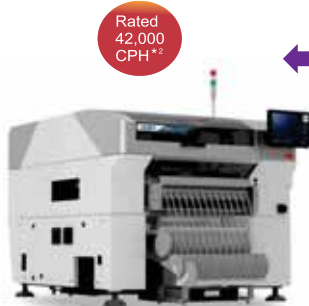


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Dynamic in-car lighting scenarios thanks to smart LED from Osram



The more autonomous a car becomes, the more the way in which it is used will change. As developments continue toward autonomous driving, more and more attention is being focused on the passenger cell. Light will become an integral part of the passenger cell, taking on functional and design-specific tasks. Previously static light, which could only be switched on and off, has now been given a dynamic dimension with the prototype of the Osire E4633i – with countless design options for car

manufacturer.

“In the future, the interior of vehicles will be more than simply a cabin for the driver and passengers. It will be an extension of our living space in which we will be able to work and relax,” explained Stephan Pawlik, Marketing Manager Automotive Interior at Osram Opto Semiconductors. “Light sources in car interiors will provide ambient lighting and perform a number of additional functions. For example, they could use dynamic and colour effects to

draw the driver’s attention back to the traffic in good time.”

To make it easier to provide such new functions in vehicles, Osram has installed a serial control driver from Inova Semiconductors in the new E4633i product from the Osire family in addition to the three colour chips (red, blue and green). In the lighting solution it is now possible for a large number of separate LEDs to be controlled via a serial bus system either individually or in groups. This provides simple implementation of uniform colour rendering across the entire colour space as well as dynamic light cases. Control of the desired colour and brightness has been simplified because the E4633i is precalibrated and can automatically correct colour shifts in the red range caused by fluctuations in temperature. The LED has an extremely compact pre-mould SMT package with a footprint of 4.6 mm x 3.3 mm x 0.7 mm. The compact package and the link to the serial bus now allow implementations with more LEDs in a much smaller space.

Jaquar displays its ‘complete lighting solutions’ at Light India 2018

Jaquar Lighting, a complete lighting solutions provider, participated at the leading lighting show ‘Light India & Electrical Building Technology India 2018’ and showcased a new range of complete LED lighting products.

Ranbir Mehra, Director, Jaquar Lighting, says, “We at Jaquar Lighting are excited to be part of the 4th edition of Light India 2018 and showcase the best of our offerings under one roof. Keeping in mind, the growing preferences of consumers towards electricity consumption, our complete range has been designed to be energy efficient without comprising on the brightness and design of the products.”

Following the theme of Light India, featuring intelligent lighting technology & applications, Jaquar Lighting showcased a wide range of lights with usage across an office, landscape,

retail, café & bar, factory, automation, etc. Moreover, the brand launched a flagship chandelier finely crafted with gold plating. The three-tier chandelier was elegantly decorated with the high-quality European crystals, but at the same time it had smart and energy-efficient lighting features. Additionally, the exhibition also had a tech enabled automation zone. He further added, “The trend of chandeliers, be it classic or contemporary have seen a major comeback. Therefore, we are presenting a range of exquisitely designed chandeliers that will be the star highlight of every modern home.”

The three-day international lighting exhibition from October 11 to 13, 2018 at Pragati Maidan, New Delhi unveiled the changing trends and latest innovation in technologies within the category.

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 - ... and many more

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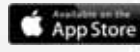
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Fulham launches new module that adds Bluetooth to luminaires

Fulham Co., Inc., a supplier of lighting components and electronics for commercial and specialty applications, announced availability of a new Bluetooth Bridge 0-10V LED controller, the first in a series of Bluetooth Low Energy (BLE) components designed to connect luminaires into a Bluetooth mesh ecosystem. The new Bluetooth Bridge can be installed in any electrical box or LED fixture to provide wireless 0-10 dimming control and monitoring.

The Bluetooth mesh standard was approved in July 2017 by the Bluetooth Special Interest Group (SIG) and offers a number of advantages for wireless lighting controls. The mesh architecture is inherently reliable with built-in failover so there is no single point of failure and luminaires fitted with the Bluetooth Bridge can be added or removed without disruption. Bluetooth



mesh also is secure and highly scalable so it can connect thousands of nodes, and it provides a full stack communications protocol platform so it can support the Internet of Things (IoT) devices as part of the network.

There are 32,000 corporate members of the Bluetooth SIG, and any compatible device that has been qualified by the SIG can connect to any other Bluetooth device over Bluetooth mesh. For

example, luminaires equipped with Fulham's new Bluetooth Bridge can be controlled wirelessly by other Bluetooth devices, such as the EnOcean Bluetooth energy harvesting wall switch (also available from Fulham).

"Bluetooth mesh shows great promise for the lighting industry, making it an ideal solution to add wireless lighting controls as part of new installations or LED retrofits," said Alvaro Garcia, Senior Director, Product Management, for Fulham. "With our new Bluetooth Bridge, installers can convert any 0-10v dimmable LED luminaire into a Bluetooth mesh node. Since Bluetooth is a recognised standard, we anticipate a number of manufacturers will develop their own BLE lighting solutions, and our new Bridge products make it possible to add any LED luminaires to the mix."

Lighting Science launches Good Day&Night Commercial Recessed Luminaires

Lighting Science, renowned for its suite of human-centric LED lighting solutions, announces the launch of the Good Day&Night Troffers, which combine the patented GoodDay and GoodNight LED engineered spectrum technologies into



one multi-dimensional circadian lighting product. The 2x2 and 2x4 troffers deliver biological benefits with

high-quality light for peak visual performance, while providing the ability to control and personalise the spectrum of lighting – truly delivering the right light at the right time.

The Good Day&Night Troffers enable users to transition light according to the natural progression of the sun, helping to synchronise the body's circadian rhythm. Users can easily switch between the focus-enhancing GoodDay and the blue-depleted GoodNight settings.

Eaton unveils a new LED street-light camera

Eaton announced the launch of the LumenSafe Integrated Network Security Camera system, which enables cities, municipalities, public facilities and businesses to integrate connected video technology onto Eaton's high-efficiency LED outdoor lighting fixtures.

"Outdoor camera systems can help cities and municipalities make their communities safer spaces where people want to live, work and

play, but typical systems can require complicated solutions to provide a source of power, communication and mounting location," said Brad Paine, vice president and general manager, Connected Communities and Homes, Eaton's Lighting Division. "...we've developed the LumenSafe system to deliver lighting and security cameras in one package as an integral part of attracting and retaining customers, employees, residents and tenants."





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IALD Announces New Director of Public Policy



The International Association of Lighting Designers (IALD) has announced appointment of Dawn P. Latham, IOM, CAE, as global Director of Public Policy. CEO Marsha Turner, CAE, said, "Ms. Latham's 25-plus years of robust association and policy experience make her well-suited to guide IALD's growing public policy efforts." Latham is charged with developing IALD's global public policy strategy and directing the Association's complex public policy efforts. She heads up a team that has expanded to include Emily Bowers, Sr. Public Policy Coordinator, and Claire Couet, IALD Regulatory Affairs Consultant for the European Union.

"We are poised to extend the IALD's reach well beyond what might be anticipated for such a small organisation," Ms. Latham commented on her new role. "I look forward to what this growing team will accomplish on behalf of the IALD and the profession of architectural lighting design."

"We have made great progress over the past decade in the global public policy arena," Turner added. "I congratulate our dedicated volunteers and our long-time public policy consultant, Dr. John Martin, on work well done. John will be retiring at the end of 2018, and we are thrilled to be able to build and expand on the excellent work that he and others have initiated."

Over the last ten years, the IALD has seen tremendous growth and expansion of its global public policy footprint. The Association has established critical working relationships focusing on lighting-related policy issues with more than 20 organisations globally and has been active on issues as varied as sales taxes, light and health, the WELLhealthy building rating system, energy codes around the world, and establishing the International Day of Light, now celebrated each year on 16 May. ■

Thor Industries Names Amelia A. Huntington to Board of Directors



Thor Industries, Inc. announced the appointment of Amelia A. Huntington to serve on its Board of Directors effective October 11. Ms. Huntington joins the Board after concluding a 30-year career in the global energy management and lighting industries, most recently serving as CEO, Philips Lighting America.

"It is an honour to join this world-class team at such an exciting moment for the outdoor recreational vehicle industry," said Ms. Huntington. "Thor is a dynamic and growing company, building North America's premier recreational vehicles and guiding the global industry into the next chapter of outdoor lifestyle, exploration and adventure."

Thor Industries is the world's most innovative outdoor recreational vehicle company. With an unwavering focus on product design and research, Thor continues to attract younger and more diverse consumers and in 2017 manufactured more than

half of North America's entire shipped inventory. In September of this year, Thor announced the pending strategic acquisition of Erwin Hymer Group, Europe's most prestigious and largest manufacturer of RVs with \$2.9 billion in annual revenue, extending Thor's global reach with an unmatched portfolio of brands, diverse products, and an unsurpassed dealer network.

"With Amy's decades of experience and successful track record in corporate leadership and industrial manufacturing, Thor will continue to lead the recreational vehicle industry and be the catalyst to connect more families and friends to the outdoors," said Thor President and CEO Bob Martin.

"Additionally, Amy's history of civic engagement and past affiliation as a board member of the U.S. National Parks New York Harbor Conservancy strategically aligns with our company positioning and passions."

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Scan the QR code to register online

Power Ministry launches award scheme under Saubhagya

Power Ministry has recently announced an award scheme under Saubhagya to felicitate the DISCOMs or Power Department of the States and their employees for achieving 100 per cent household electrification in their area of operations. Awards would be provided for achieving 100 per cent household electrification at DISCOM/Power Department level of the States. Eight States which have already achieved more than 99 per cent household electrification prior to launch of Saubhagya (Andhra Pradesh, Gujarat, Goa, Haryana, Himachal Pradesh, Kerala, Punjab and Tamil Nadu), are ineligible for participation under the award scheme. All the remaining States and their DISCOMs are eligible for the award.

Award will be given in three categories, (i) DISCOMs / Power Departments of Special Category States (which includes seven North Eastern States, Sikkim, J&K and Uttarakhand); (ii) DISCOMs / Power Departments of other than Special Category States (which includes Bihar, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Telangana, Uttar Pradesh and West Bengal) having more than 5 lakh un-electrified households and (iii) DISCOMs / Power Departments of other than Special Category States having less than 5 lakh un-electrified households.

There will be two quantum of award in each of the three

categories. Under first quantum of award, the 1st DISCOM / Power Department to achieve 100 per cent household electrification by 30th November 2018 would be provided cash award of Rs. 50 lakh. The Principal Secretary (Energy/Power) of the State will devise the mechanism to distribute this cash prize amongst employees of the concerned DISCOM / Power Department. From this amount, Rs. 20 lakh will be given to the division of DISCOM/Power Department with highest number of households electrified. Certificate of appreciation would also be given to five officials of concerned DISCOM/Power Department of any level from managing Director to Lineman to be nominated by the Principal Secretary (Energy / Power) of the States. The second quantum of award includes cash award of Rs. 100 crore as grant to the concerned DISCOM/Power Department to be spent in distribution infrastructure development in their area of operation. The Principal Secretary (Energy/Power) of the State will decide work to be executed from this amount.

Other DISCOM/Power Department of the States to achieve 100 per cent household electrification by 31st December this year would also be provided certificate of appreciation for five officials of any level from managing Director to Lineman to be nominated by the Principal Secretary (Energy / Power) of the States.

Eaton starts accepting applications for annual SOURCE Awards

Power management company Eaton announced the call for entries for the 42nd Annual SOURCE Awards, Eaton's lighting design competition dedicated to celebrating the next generation of lighting professionals and building the pipeline of industry talent.

University students studying architecture, design, engineering or related disciplines are invited to enter this conceptual design competition focused on furthering the understanding, knowledge and function of lighting as a primary element in design. The deadline to submit entries is February 25, 2019.

The SOURCE Awards competition is open to students currently enrolled in undergraduate or graduate programs in lighting or interior design, architecture, engineering or related disciplines. Students are eligible to enter projects based on

conceptual lighting designs and will be judged on creativity and how Eaton lighting and controls products are used in conceptual spaces.

Each project will be judged on its own merit and selected entries will earn the distinction of Winner, Honourable Mention or Special Award of Recognition. The winner will receive a \$2,000 award and honourable mention winners will each receive \$500.

Judging for the 42nd Annual SOURCE Awards competition will take place in March 2019 by an independent panel of lighting and design professionals who have taken part in the SOURCE Awards in the past, as well as a representative from the SOURCE. Winning students and their faculty advisors will be announced and recognised in May 2019 at LIGHTFAIR International in Philadelphia.



Musikmesse & Prolight + Sound 2019: *Stronger together!*

Two fairs at the same time and place: next year's Musikmesse and Prolight + Sound will be held concurrently on all days, from 2 to 5 April.

For four days, visitors can discover the entire spectrum of products for the music and live-entertainment sector. "Musikmesse and Prolight + Sound are combining their strengths. With all days now concurrent, we are complying with a request often expressed in the sector", says Michael Biwer, Group Show Director of the 'Entertainment, Media & Creative Industries' Business Unit of Messe Frankfurt Exhibition GmbH. "The concept for 2019 emphasises the strengths of



the two trade fairs: professionalism, internationality and the synergistic effects between the industries represented."

BUSINESS FIRST

With free admission on all days of the fair, free cloakroom service, guided tours and many other benefits, the

'Insider' VIP programme means qualified dealers receive first-class treatment. In 2019, the programme will be extended to include buyers from the entertainment-technology sector. Now also part of both fairs is the Matchmaking programme, which brings exhibitors together with visitors of particular relevance to them.

New next year will be a joint Hall for Business and Networking for both Musikmesse and Prolight + Sound (Hall 4.1), which will take the form of an elaborate lounge with a lecture stage and catering zones, all designed to encourage business discussions in a relaxed atmosphere. ■

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Future of *LED* Market in India

While the demand for a smart and connected lifestyle is a driving force behind the LED lighting industry, the industry faces a number of challenges.

– Mahesh Bellad



Image Courtesy: www.alphalighting.co.nz

The LED lighting industry has grown over the past decade and only continues to spur at rapid rate hereon, owing to its numerous benefits over the older technology. Declining LED prices coupled with favourable government initiatives shall drive LED Lighting

market in India until 2020. Increasing adoption of LED lighting is being witnessed across commercial and residential sectors, government projects, upcoming smart building projects, etc.

Key factors that are expected to boost

the market include declining LED prices coupled with favourable government initiatives to provide LED lights at subsidised cost and LED installation projects for streetlights. Moreover, rising consumer awareness about cost-effectiveness and eco-friendliness of LED lights would continue to drive volume sales from the residential and well as commercial sectors.

INNOVATIONS

There's a lot of innovation that is still happening and is untapped. So, the LED lighting industry is going to constantly keep evolving. To name a few notable innovations, here are some:

- LEDs have become notably mainstream, though it has taken time but it's only going to go a notch higher every time.
- LEDs would be controlled lighting which has already set in, but still is not as mainstream which is connected and smart way of living.
- IoT shall be next where several devices shall be linked to one as lighting has become like data. Technologies such as Li-Fi which track people's positions to use luminaries.

CHALLENGES

In terms of challenges, since the LED lights range from a much lower price, local manufacturers receive low margins which in turn brings intense competition from Chinese Players, as their products are available at cheaper price points though of substantial quality. Essentially the levy of GST on LED lights and raw materials range nearly between 18 to 28 per cent which causes heavy revenue leakage. Lack of technical standardised

norms for the lighting industry is also another factor. Due to the adoption of the proper policy by most countries, local manufacturers are facing a major setback in their process and thereby affecting the LED lighting industry.

FUTURE LOOKS BRIGHT

Currently, the demand for LED lighting in India is largely driven by Metros, because of stronger awareness. However, in future the demand is also expected to grow from Tier 2 and Tier 3 markets especially on street lighting and industrial lighting categories. Further, expansion of government initiatives will open up new markets for the LED lighting industry.

Smart Cities or National LED Programme and several other government initiatives have put LED market in spotlight and also have led to a stronger growth. Not only have the prices reduced drastically, but also better acceptance among the audience. With growing awareness, there is a massive growth opportunity for the next 5-10 years. The demand will be mostly dominated around outdoor lighting like streets and roads.

The sector is expected to grow in full swing, due to the expansion in infrastructure development such as roads etc, adding to which with socio-economic growth and growing preference of people towards energy efficient and innovative lighting solutions, the next steps are well defined. Consumers too have become very environment friendly, which has further built the push. The journey is very exciting, though has its own share of challenges. Lastly, the government's programs such as 'Power for all' etc will keep the momentum going. ■

Currently, the demand for LED lighting in India is largely driven by Metros, because of stronger awareness. However, in future the demand is also expected to grow from Tier 2 and Tier 3 markets especially on street lighting and industrial lighting categories.



Mahesh Bellad
Director
Online Instruments
Orange LED Plus

Lighting *Beyond* Illumination

Discover the power of connected lighting

– Subhajit Roy, Group Editor

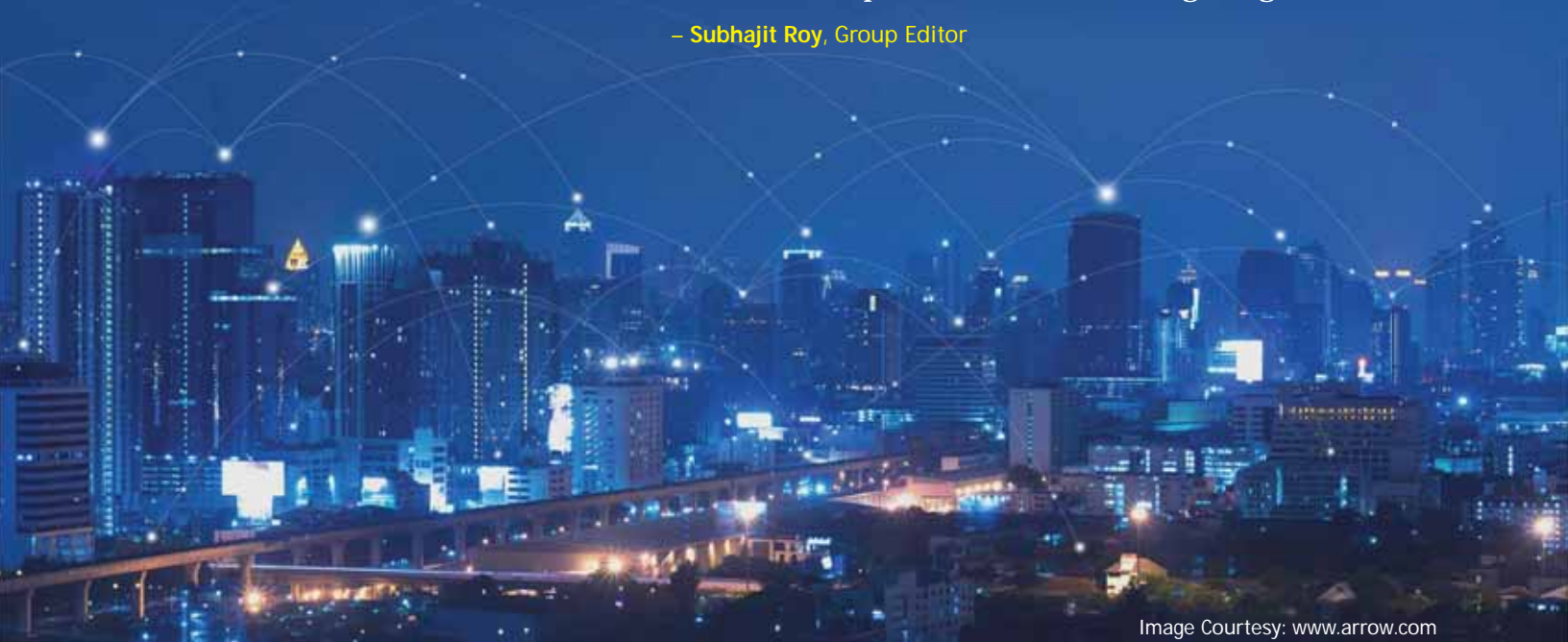


Image Courtesy: www.arrow.com

Digitisation is transforming the way businesses, governments and consumers interact with the physical world. Lighting industry is poised to be the next digital disruptors thanks to increasing adoption of Internet of Things (IoT). The IoT, being referred as the next industrial revolution, allows connectivity to devices and enables one device to communicate with another device using data. An IoT lighting system also enables connectivity and communication between devices within the lighting system and between lighting devices and non-lighting devices.

According to Navigant Research, global market revenue for IoT lighting is expected to grow from \$651.1 million in 2017 to \$4.5 billion in 2026 whereas McKinsey report projects that the

worldwide market for IoT lighting to grow to approximately \$159 billion by 2020.

"Technology of connected lighting is new and still evolving in India. Moreover, the emergence of Big Data and the IoT are going to bring much more intelligence into lighting systems," said Raja Mukherjee, President & Country Head - Illumination, Bajaj Electricals Ltd.

HOW CONNECTED LIGHTING WORKS

Giving a brief about how connected lighting works, Raja Mukherjee said, "Connected lighting can work through wireless media like RF (Radio Frequency), mesh media or through wired media like PLC (Programmable Logic Controller). The information gets



Technology of connected lighting is new and still evolving in India. Moreover, the emergence of Big Data and the IoT are going to bring much more intelligence into lighting systems.

Raja Mukherjee
President & Country Head
- Illumination, Bajaj
Electricals Ltd.

Smart Offices

captured through the sensors and gets communicated through the wireless or wired communication media to a central hub which then passes the information on to the Cloud. At the Cloud, data analytics is done and processed and sent back to the respective users to their smart connected devices such as handheld tablets or smartphones or any smart console."

APPLICATION AREAS

Connected or Smart Lighting can be broadly categorised into two types; Smart Outdoors and Smart Indoors. Smart Outdoors can be smart street lights which use lighting as an architecture for surveillance, pollution control, motion detection, car parking sensors and real time traffic control through smart lighting.

Smart Indoors on the other hand can connect the peripherals like split AC modules or curtains using lighting as an architecture or venison blinds. These devices should however have an IP address and through a common platform they will be able to communicate with each other, informs Raja Mukherjee.

"IoT is here to stay and grow and we are seeing that integration happens in our products. Today we are able to integrate

the communication and electronics into street lighting and office lighting systems where we are having much smarter solutions," said Gautam Seth, Joint Managing Director, HPL Electric & Power Ltd while talking to Lighting India on the sidelines of recently concluded Light India exhibition.

HOW CONNECTED LIGHTING CAN TRANSFORM THE WAY WE LIVE

Connected lighting is the future. Pre-programming helps manage your time schedule efficiently. It also saves a lot of energy and time by optimising the efficiency of various devices. Connected lighting also helps to reduce the waiting time at signals through real time traffic control and monitors anti-social activities through surveillance. It also provides intelligent lighting solutions like having the right amount of light at the right place, increasing and decreasing the brightness of lights accordingly through motion detection.

However, Puneet Dhawan, Senior VP and Business Head-Lighting, Orient Electric, opines, "Lighting industry is evolving very fast both in terms of technology and the associated cost. The future depends on both: technology has to become simpler and cost has to become affordable for consumers. Otherwise it will remain a niche market."



Today we are able to integrate the communication and electronics into street lighting and office lighting systems where we are having much smarter solutions.

Gautam Seth
Joint Managing Director
HPL Electric & Power Ltd.



Photo - Bajaj Electricals

Smart LED Street Light



The future depends on both: technology has to become simpler and cost has to become affordable for consumers. Otherwise it will remain a niche market.

Puneet Dhawan
Senior VP and Business
Head-Lighting, Orient
Electric

THE WORLD OF CONNECTED LIGHTING

Bajaj Electricals is working on wireless platforms, fixtures and smart poles. The company also has sensor-based street lights for outdoors and individual based lighting controls for indoors. "We are working towards making each luminaire intelligent, wherein, it captures and processes data and communicates it with the other luminaire. And, human-centric lighting that will adjust to an individual's biological clock and adapt accordingly," informs Raja Mukherjee.

Voice command was one of the most revolutionising inventions in the field of AI or IoT. And now, the world is racing towards a whole new era of intelligent products which can be controlled simply by using voice from anywhere with Internet access. Home-grown Syska has introduced a fully functional lighting

system with WiFi module which is compatible with Amazon Alexa, allowing users to control the lights using voice. Running on AI/IoT platform by Tuya Smart, Syska Smart bulb can easily respond to voice command given by users once synced with Echo Dot, Echo, or Echo Plus.

Along with WiFi modules, Syska Smart bulb works with a variety of networking



Continued on page 27

THE IMPOSSIBLE IS OFTEN THE TASKS UNTRIED



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modes like Bluetooth, Bluetooth Mesh and more. It also allows consumers to control the lighting of their home from anywhere in the world within seconds through a mobile app called the 'Syska Smart Home'.

Bath fittings and sanitaryware major Jaquar is pushing the boundaries of intelligent lighting. According to Mohit Sharma, Business Head – Lighting, Jaquar & Company Pvt Ltd, "Slowly lighting will also go into software way with IoT. We have advanced lighting solutions featuring sensors and automations so that these can be controlled centrally. We also have developed lighting system with CCMS which enables monitoring and operation of the installed street lights from a centralised location. Though we are comparatively new in this domain, we will be a top player within a couple of months."

At the recently concluded Light India 2018 exhibition, Jaquar Lighting launched its latest copper chandelier finely crafted with silver plating that is equipped with intelligent lighting features which pull through the fluctuations of high/low voltage and high/low temperature. Jaquar Lighting offers complete lighting solutions – for residential, commercial and outdoor use.

C by GE and Google brought a new level of simplicity to smart lighting control. Without the need for an extra hub, you can soon use either the Google Home, Google Mini, Google Max or the new display product, Google Home Hub, to control your C by GE bulbs. Simply screw in a C by GE bulb and make sure one of



C-Sleep Smart Bulb

these Google Home products is on, and the Google Assistant will automatically detect the bulb in the Google Home app. Then just say "Hey Google..." to turn the bulb on and off, dim it or control it otherwise with your voice.

Talking on Orient Electric's IoT preparedness, Puneet Dhawan said, "In lighting, we have some products which are connected smart, but we have gone on a limited extent to be able to absorb what is happening in the market. Also, as a group company, we are in the process of developing a common platform which will get evolved for all our products i.e. fans, lighting, home appliances, switches. A single Orient app will be able to control all our products – not only lighting. We are evaluating all the options like Bluetooth and WiFi. By the end of this year, we should be able to launch common platform for all our products."

This year HPL Electric & Power Ltd has completed one of the first smart city lighting projects in India. The company has installed complete smart lighting solutions in Bhopal, as a part of the city's smart city project. "In Bhopal, we have completed installation of over 20,000 smart LED lights and 400 CCMS (Centralised Control Monitoring System).

Here each and every street light is connected to centralised server and can be centrally monitored using 6LoWPAN communication technology," informed Gautam Seth.

Though Seth agrees that it is still too early for connected lighting for mass adoption, he believes, "it is moving in the right direction as mobile connectivity is improving". ■



Slowly lighting will also go into software way with IoT. We have advanced lighting solutions featuring sensors and automations so that these can be controlled centrally.

Mohit Sharma
Business Head – Lighting,
Jaquar & Company Pvt Ltd

Improve nature: Horticulture Lighting from OSRAM Opto Semiconductors

LEDs from OSRAM Opto Semiconductors deliver energy efficient lighting solutions for various LED lighting applications.



IMPROVE NATURE

The concept of ensuring future food supply is more than a nice place for plants. It's truly a high-tech farm with a huge amount of technique to provide the optimal conditions for plants to

grow. Here, details do matter. Like the right mix of wavelengths to stimulate photosynthesis or the reliability of deployed technology in this challenging environment.

So, when it comes to horticulture

lighting choose LED components from a partner with decades of experience and the power to help you accomplish your project. OSRAM's broad portfolio of powerful and robust LEDs offers a spectrum of infinite possibilities – especially for modern farming techniques such as top lighting or vertical multilayer farming in addition to daylight or as single lighting sources. It covers the complete range of specific illumination requirements needed for

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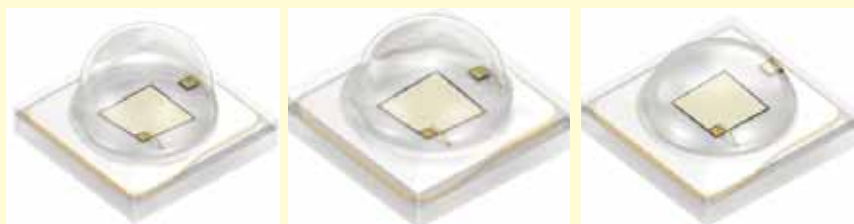
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APPLICATIONS

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APPLICATIONS

- Horticulture lighting
- Accent and effect lighting
- Architectural lighting

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Lighting Market for *Art & Museums* Applications

“The rapid growth in wealth, particularly at the high-end, has fuelled stronger buying in the global art market as well as vibrant local art scenes throughout Asia,” explains Aurelio Volpe, Director - Market Research at CSIL Centre for Industrial Studies.

– Aurelio Volpe



The niche of lighting solutions for “Art & Museum” represents a relatively small part of the nearly US\$ 100 billion lighting fixtures market, at world level; still, it is a very prestigious one. According to CSIL estimates, the indoor market for “Art & Museum” lighting is worth at least half billion US dollar worldwide, of which almost US\$ 400 million when considering only LED solutions. This market can be geographically broken down in 40 per

cent Asia, 40 per cent Europe (including North Africa and Middle East), and 20 per cent in America. In addition, several hundred million US dollars should be added when considering also the specific niche of architectural (outdoor) lighting for heritage buildings and monument lighting.

Museums and galleries consume significant amounts of energy to maintain an internal environment that

protect and preserve their collections. In addition, light in museums and galleries are not only limited to the display of art, as they range from the exhibition and sculpture garden to the shop and café. The use of lighting within both exhibition and back of house areas can account for 20 per cent of this energy consumption, according to Arup estimation. The new possibilities of high-quality LED lighting allow to optimise the operations, without having to compromise in terms of visual experience and the conservation of art. Therefore, as a minimal criterion, a good solution should reduce maintenance and operational costs with the long-life LED lighting, allowing maximum flexibility for temporary exhibits and last-minute lighting adjustments. Additionally, it should preserve the authenticity of the artwork with LED lighting that keeps colours true (with Colour Rendering Index – CRI – higher than 90, typically 96 or 98), attract and guide visitors with light-driven visual contrasts that showcase the smallest details and evoke emotions. Last but not least, lighting solutions developed for art pieces should protect them with LED lighting that emits no harmful UV or IR rays, meeting the international criteria for art conservation with uniform LED light.

A few lighting manufacturers can comply with such requirements. A not exhaustive list of relevant players in the “Art & Museums” LED lighting niche includes: Philips, Osram, Erco, Inesa Feilo, iGuzzini, Lumenpulse, Shenghui, FSL, Targetti, Acuity, Martini and Bega. Frequently, companies that specialise in indoor “Art & Museum” lighting also operates in the high-end segment of the Retail business such as Exenia, Martini, Fagerhult, Viabizzuno, Luxiona

and Linea Light. Philips and Bega are more active in the outdoor segment, while Erco and iGuzzini are the leaders for indoor solutions, even if they play a relevant role also outdoor business.

EUROPE

Around 20,000 museums are in operation in Europe and the average spending for new lighting every five to 10 years is estimated to be worth around € 50,000. Europe is home to 17 of the largest museums in the world. Seven of them are located in London, three in Paris and in Madrid, two in Barcelona, and one each in Rome and Florence. Such an environment has created the perfect space for many European companies to specialise in this niche of the market; among them, Erco and iGuzzini stand out.

In Europe, Erco has provided its lighting solutions to the top cultural institutions, including the Pinacoteca di Brera in Milan (Italy), the Archaeological Museum in Madrid (Spain), the Galleria degli Uffizi Museum in Florence (Italy), the National Gallery in London (UK), the Guggenheim Museum in Bilbao (Spain), just to mention some of the most prestigious ones. In the recent years, Erco has developed the new Compar range of recessed luminaires with a striking linear design that delivers light distributions previously restricted to round or square ceiling apertures. As a result, Compar adds to the design options in typical recessed lighting applications such as foyers, circulation areas or conference rooms in museums, administration buildings, restaurants or galleries whilst also meeting every ergonomic requirement for perfectly efficient lighting solutions in the office environment. Dali options are available for many luminaires, for example for

The new possibilities of high-quality LED lighting allow to optimise the operations, without having to compromise in terms of visual experience and the conservation of art.



the Stella projectors.

Among the recent products developed by iGuzzini for Art and Museum applications, there are: Laser Blade xs (extra small wall washer) in the field of indirect lighting, "Walky" (that received a German award for outdoor wall-mounted), "Palco InOut" (outdoor projector), "Palco low voltage" (miniaturised projector), "The Blade" (awarded from the German Design Council). With its Laser Blade series, iGuzzini has shown how daft miniaturisation of lighting can get: its Laser Blade XS encapsulated optical mastery and innovative knowhow in just 18 mm. iGuzzini has developed lighting solution for very prestigious projects such as The Last Supper by Leonardo da Vinci (Italy) and the Royal Academy in London (UK). Among its latest projects, it worth mentioning the just inaugurated lighting system for the Scrovegni Chapel in Padua (Italy), which

iGuzzini has developed in partnership with WiSense, an innovative start-up founded in 2014 as a spin-off of the Polytechnic University of Marche. The new IoT lighting system includes integrated LED luminaires, environment sensors and sophisticated internet-protocol software. In an initial phase, sensors designed specifically for the 14th century Italian church housing the frescoes will measure the variations in natural light. The data will then be processed in the cloud using a bespoke algorithm to adapt the artificial lighting at the

Scrovegni Chapel to any changes in environmental conditions. The asymmetrical distribution of the six windows on the southern facade of the chapel produces an uneven distribution of daylight, as the windowed wall enjoys less natural light than the one opposite it. This creates constant changes in the environment's visual balance and a counter light effect that troubles visitors. Thanks to the new system, the light variations will be detected and transmitted to the control system that will adjust the luminaires accordingly.

Other relevant European companies active in this segment are the Italian lighting manufacturers Targetti and Disano. In 2015, Targetti has introduced the "Lights of Florence" system for enlightening Art & Museums, historical buildings and religious spaces. In the last few years, Disano has worked on the illumination of the Bamburgh

Continued on page 35

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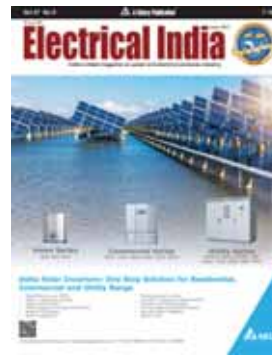
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Continued from page 32

Castle, in Northumberland (UK); it provided lighting solutions for the big statue on top of the Sanctuary della Madonna della Guardia (Our Lady of the Guard) in Tortona (Italy) and the Church of Santa Maria di Caravaggio (Our Lady from Caravaggio), which occupies a large space near Porta Ticinese, one of the most important medieval city gates in Milan (Italy). The church's lighting system was recently renovated with new spotlights, LED sources and control systems that allow pre-programmed switching times.

THE USA & EMERGING MARKETS

On the other hand, nowadays the US is the largest art market worldwide, accounting for 42 per cent of the art sales by value, with China in second place (21 per cent), according to the The Art Market | 2018 (released by UBS and Art Basel). Although exhibitions are much more globally dispersed than sales in the art market, the US dominates also this segment, accounting for a 21 per cent share. Its share is almost twice that of Germany (12 per cent) and France (10 per cent), at the second and third position respectively.

Such a supremacy allows many US manufacturers to specialise in the "Art and Museum" niche of the lighting market. Two interesting companies in this field are Litelab and Edison Price Lighting. Litelab has over 30 years of experience in the United States. Their luminaire collections provide a full range of architectural lighting solutions from the simplest to the most complex lighting challenges. The Arts and Museum market accounts for 45 per cent of the company revenues. Its portfolio includes the Museum of Modern Art (New York), North Carolina Museum of Art (Raleigh) and Grand

Rapids Museum of Art (Grand Rapids). Edison Price Lighting has designed and manufactured high-quality architectural lighting fixtures since 1952. They have lit over 400 museums and galleries, as well as offices, residences, academic buildings, and more. They are represented in North America by over 60 manufacturer's representatives with a total of 100 branch offices. Their projects include the refurbishment of the lighting fixtures for the United Nations and lighting the new 9/11 Memorial Museum.

Considering emerging markets, combined with China and India, the Asian region accounted for 32 per cent of world wealth in 2017 and wealth in the region in absolute terms has increased 48 per cent in 10 years and by over 160 per cent since 2000. The rapid growth in wealth, particularly at the high-end, has fuelled stronger buying in the global art market as well as vibrant local art scenes throughout Asia. As wealth in Asia has grown, demand for art, as a luxury good or cultural commodity, has increased. This demand has been met through local sales of art as well as purchases abroad by Asian collectors in already established markets such as London and New York. Further evidence of how these wealth dynamics have affected the market is that Asia has become a significant importer of art (accounting for 17 per cent of total global imports of art), with Hong Kong accounting for over 50 per cent of the imports of art to Asia and 8 per cent of world imports of art and antiques. As a result, many Chinese manufacturers of lighting fixtures, such as Inesa Feilo, Shenghui and FSL, are now getting more and more interest in the Art & Museum lighting business. ■

Considering emerging markets, combined with China and India, the Asian region accounted for 32 per cent of world wealth in 2017 and wealth in the region in absolute terms has increased 48 per cent in 10 years and by over 160 per cent since 2000.

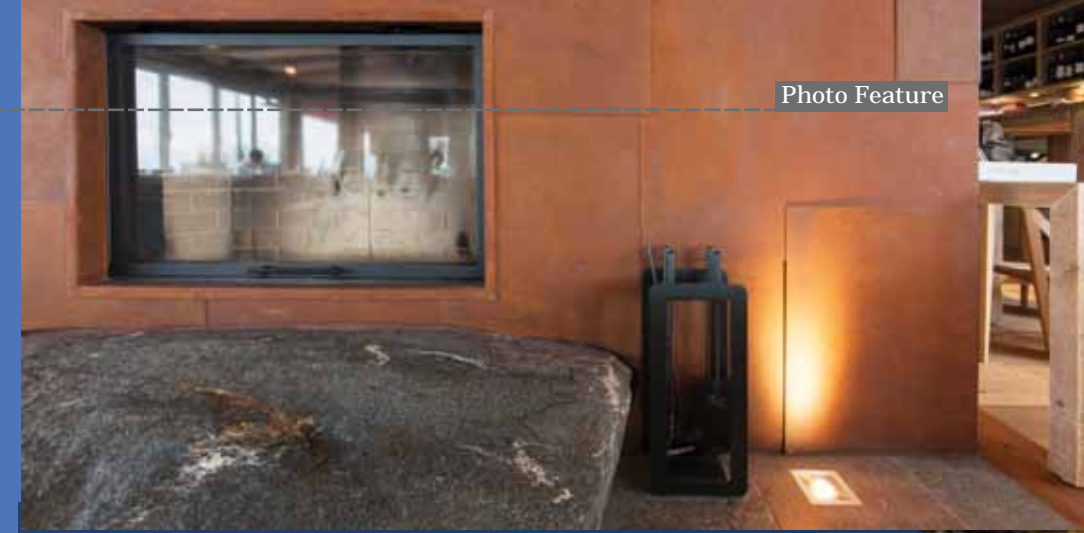


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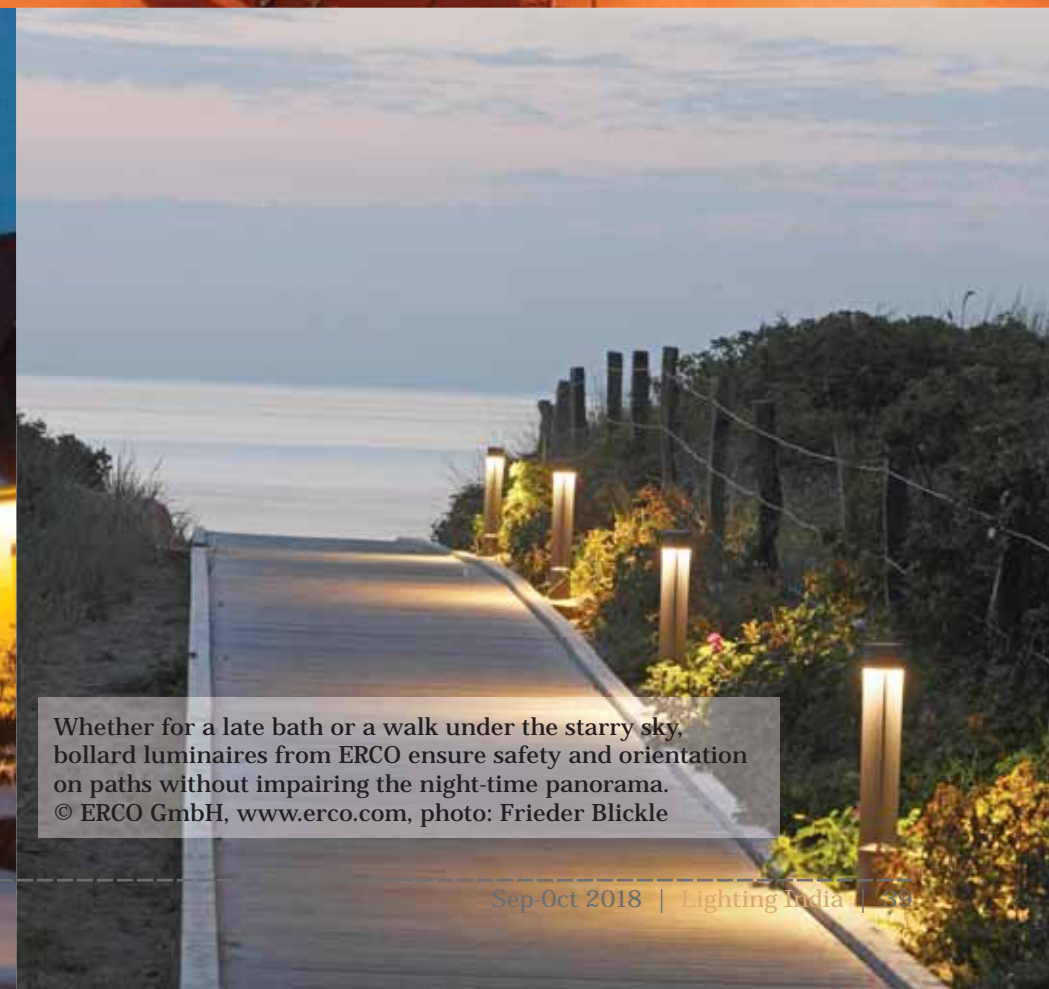
In the brilliant and warm light of ERCO's LED lighting tools, the historic roof construction of the converted reed barn becomes an impressive backdrop for events of all kinds.

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After sunset, the 75-hectare castle park can be rediscovered. ERCO's efficient spotlights impressively showcase the old tree population with low energy consumption.

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Whether for a late bath or a walk under the starry sky, bollard luminaires from ERCO ensure safety and orientation on paths without impairing the night-time panorama.

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Smart Stargazing in Genk

The design - comprising the 275 Stars - was chosen both for its aesthetics, smart technologies, innovation and functionality.

Photos courtesy: [Alkatech](#)

The Belgian city of Genk in Limburg recently switched on a fabulous new civic lighting installation called "Genker Ster" (Genk Star). The piece of light art was designed by creative lighting and

visual design practice Painting with Light, and enables the community to enjoy the fun and excitement of a unique 'architainment' concept all year round.

The permanent lighting installation was the brainchild of Genk Mayor Wim Dries. Ambient lighting has been part of the vibrant and forward-thinking city's festive experience for the last decade,



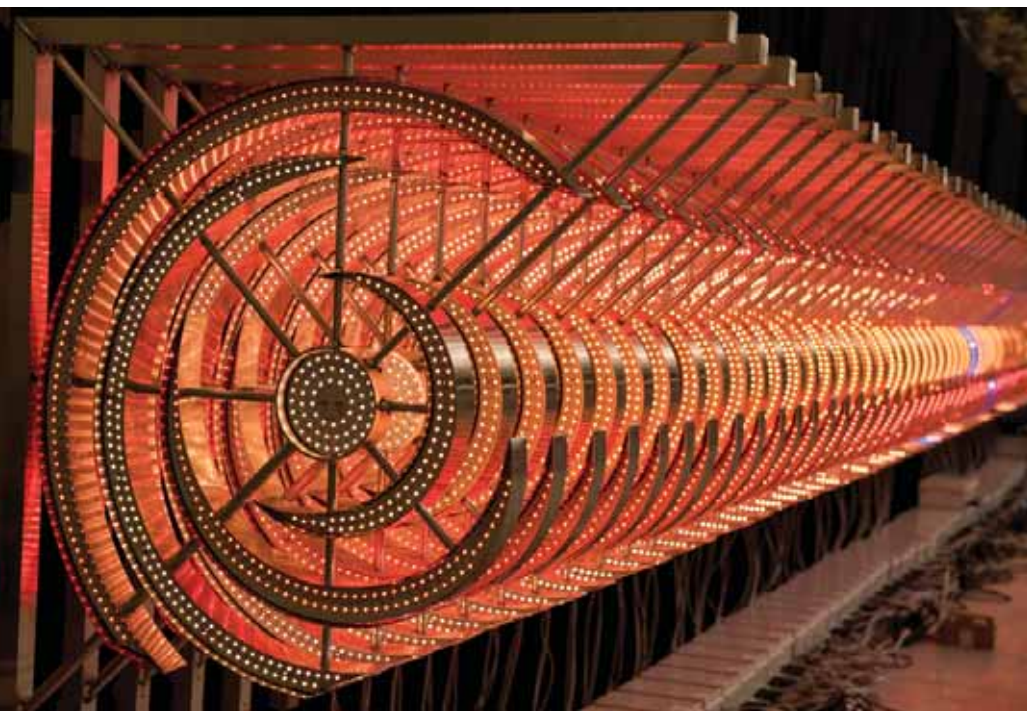
however the new Stars can now make an atmospheric impact throughout the year.

Once the project was green-lighted by the city council, a tender was issued for a concept design and specification which was won by Painting with Light.

The design - comprising the 275 Stars - was chosen both for its aesthetics, smart technologies, innovation and functionality.

A second tender was then issued for the technical design and manufacturing of the Stars, which are distributed around the city centre ... attached to building facades and other objects. This was won by another local company, Alkatech, and also involved close consultation with Painting with Light's creative director Luc Peumans and his team.

The illuminated Stars feature four elegant, varying length curved elements winding around a centre-point and



tapered at the ends, held in place by eight prongs. The Stars themselves are constructed from brushed aluminium.

Each Star contains 2,064 LEDs which can change colour, twinkle and be programmed to create multiple effects.

Painting with Light is also based in

Genk, so everyone in the company was delighted to be involved in the project.

"It's a great honour to be asked to imagine and deliver an active, living and sustainable contribution to life in Genk using the art form I know and love. I hope it will engage people and add to the bustle and energy of the city," stated Luc.

He explained that the concept and thinking behind the structure of the Stars was to create an attractive shape that was timeless, universal and globally secular, but that could also be associated with Christmas. It had to please everyone as well as delivering a touch of magic to the urban downtown environment.

Meeting all these parameters was the challenge, and arriving at the final shape was an evolutionary process, however Luc's experience in the fields of entertainment and architectural lighting, storytelling and media concepts all contributed to their winning product.

Every pixel of each star contains two LED packages. The first is RGB for a full range of saturated colours and the second is a combination of warm and cold whites and amber ... for a comprehensive array of authentic-looking whites. These are also ideal for the cosy, golden amber glow required for the Christmas season.

However, this complete flexibility of the Stars means they can be programmed to reinforce or reflect a number of occasions ... far more than just traditional Christmas lights.

Painting with Light already has an advance calendar of upcoming events in the city, like May Day, etc. and including the home match dates of



nationally ranked football team, KRC Genk.

The Stars have already become part of Genk's social fabric - highlighting occasions by running special colours and lighting sequences. All content has also been supplied by Painting with Light, and new content will be produced as required according to activities in the city, establishing a library of material that can be stored for future use.

The Stars also make long-term financial sense as a far more cost-effective solution for the city, rather than spending money putting up and taking down a single festive lighting display each year (as was the case with the traditional Christmas lights).

The installation utilises a unique control system developed by Alkatech, with adaptability at its heart. Every LED pixel in each Star can be individually controlled to display around 270 trillion colours and is sent data via a cloud-based server which is synchronised by the internet clock.

Data is sent via a 4G SIM card embedded in the Star, and can be accessed locally or remotely via LedNet, a control platform devised by Alkatech as a potential SmartCity comms protocol. This can also be used for other tasks like monitoring air quality or activating / accessing other devices.

The LedNet devices can receive instructions via Ethernet, WIFI or – in this case – SIM card, and they can be programmed via a calendar app and also support live streaming. The City of Genk can control and change or update the calendar App via smartphone or web page as needed.

Art-Net compatibility means a LedNet controlled system can be integrated



into an entertainment lighting system that might be installed temporarily for a special concert or a festival staged in one of the city's public spaces ... so the Stars can be integrated and run as part of their light show.

With the exception of the LEDs, all elements in this project have been created, developed, designed and invented in Belgium, with 80 per cent of that 'Belgian' DNA coming from the Limburg region itself, the designer claims.

"A system like this can add value and great vibes to any city, space or place for that matter! I can envision many future uses for this technology including theme parks, visitor attractions and all types of built environments," Luc concludes. ■

Lighting Design for Monuments

Architect-cum-Urban Planner Ashish Batra explains some simple yet effective basic fundamentals by adopting which one can achieve the perfect illumination of monuments or artworks or sculptures.

Charminar in Hyderabad, India with temporary celebratory occasional lighting



In any city illuminating monuments in a recognised manner brings out traces of the historical past in urban cityscape as well as landscape. Monuments recalling and showing respect for important persons or events are often located on pathways, in public squares and city parks where they form the end point of an axis line or stand in the centre of observation themselves. A determining factor for ensuring that monuments are noticeable from a far distance is the luminance contrast with respect to the surroundings. In a rural or large open area context with a low ambient illumination, low illuminance levels are sufficient for highlighting a building or structure, but a brighter urban environment (along pathways or in public squares) will require a correspondingly brighter emphasis to achieve a comparable contrasting effect.

A fractionally higher illuminance level will often serve for giving significant buildings or monuments an intensive effect from a far distance. However, as the structure is approached, the focus shifts from the overall image to details such as reliefs of engravings or lettering etc. A brightness level that is too intensive would dazzle a viewer and be recognised as annoying. The possibilities for lighting design for monuments range from ultra-fine, uniform illumination to meaningful, temporary lighting concepts for celebratory occasions.

When deciding on the right lighting concept for any monument, the history and usage of the monument play a critical role. Memorials that celebrates a difficult past and serve as a place of historical observation and grief should use a differentiated lighting design to respectfully bring out that history and to offer the individual visitor a better atmosphere for meditation. What

definitely must be avoided in such cases is uniform lighting with high illuminance levels and the glares.

Monuments that boldly mark positive events and symbolise national pride (like India Gate in New Delhi, Refer Figure 2) permit a different approach to lighting. Light enables history to be clearly presented also at night and even to be dramatically showcased with special effects on public holidays or special days. Sometimes cultural monuments can serve as the geographical centre or major landmark of the city both day and night and as backdrops for concerts or events, while bringing history back to life. Below given are the few basic fundamentals to be adopted while designing lights for monuments.

RESPECT THE HISTORY

A respectful behaviour towards history is also reflected in the lighting design; one that places the lighting in the service of the structure or monument rather than putting the lighting centre stage. The India Gate Memorial in New Delhi of India, honouring 70,000 soldiers of British Indian Army who died in the First World War, is noted for its simple lines and impressive lighting design.

The US Air Force Memorial in Arlington, Virginia is much monumental, with its three divergent pillars soaring over 80 metres up into the sky. Designed based on the moisture trails of a formation flight activity, its metallic stainless-steel surface makes the sculpture visible from afar distance (Refer Figure 3). Illumination is provided by narrowly focused beams from precisely aimed projectors. These are equipped with powerful metal halide lamps.

The lower part of this monument is



India Gate in Delhi with unique approach of lighting

illuminated by projectors located directly on the plinth area of the curved pillars. Uniform lamps simplify maintenance of the installation and ensure the lighting quality remains constant.

ILLUMINATING SCULPTURES

Artistically designed objects such as sculptures take on an important role in the pictorial language of monuments for paying tribute to any persons or events. When apply light to shape these monuments during dark, it is not only the light's angle of incidence that is relevant but also its direction is important. A frontal light, by which the direction of the light is the same as the observer's viewing direction, will produce a low modelling effect. A shadow will be barely noticeable and the three-dimensional objects will appear flat.

Conversely, a light from the side of the sculpture will produce very strong

contrasts between light and shadow with an intensive three-dimensional effect for the viewer. Similarly, an overhead light, whereby the light is incident on the object from directly overhead, greatly

highlights the upper surfaces of the object but often causes the sides disappear into the darkness and casts a spotlight circle on the ground.

Backlighting with a light source behind the object casts a long shadow towards the observer, leaving the object as a dark profile with just a thin border of light outlining the upper contours. Floor lighting illuminates sculptures from underneath and often gives an uncommon effect because the direction of light is the opposite to that of daylight. These effects not only hold true for sculptures or monuments but are also relevant for object lighting in general way. Refer Figure 4 for a picture showcasing the perfect luminance contrast to surroundings along a walkway to perceive the queue of sculptures from a distance.

MONUMENT AS A BACKDROP

Cultural monuments provide spots with a unique atmosphere for festivals, events or concerts. Often situated



US Air Force Memorial, Virginia with précised narrow focused illumination



Taj Mahal as illuminated monument in the backdrop

within landscapes of particular area, these structures can be used as a stage set for concerts, events or performances, lending them a surprising backdrop or even embedding them in the historical contexts. In such cases, the lighting can express the theme of the event. Refer Figure 5 for picture showcasing the live concert done by famous keyboardist and music producer “Yanni” in 1997 using backdrop of one of the seven World’s Wonder “Taj Mahal” monument of India.

Lighting control systems and luminaires are capable of different colours enable great flexibility for setting up light scenes and sequences. A perfect lighting control system can control the flowing transitions between the different dramatic light scenes as per the event, festival or concert.

LUMINAIRE SELECTION

The key tool for lighting sculptures or

monuments are projectors and floodlights, and luminaires for open area and walkway lighting. There are only two principles important for mounting the luminaires, giving rise to two different aesthetics; “integrated and additive lighting”.

With integrated lighting, such as in-ground or in-wall luminaires, it is the landscape and the architecture that comes to the emphasis; the focus is on the light not the luminaires. Conversely, with additive lighting, such as surface-mounted luminaires, the luminaires act as an architectural feature in their own right. In the case of existing monuments or sculptures, mostly the utilisation of integrated lighting is important in accordance with the listed building regulations or laws (if any).

The options for the lighting technology to be adopted are barely influenced by the decision for an integrated or additive concept. The main criterion for

choosing the luminaire includes the visual comfort, the light distribution, the options for accessories and the choice of various types of lamps. The architect or lighting designer can obtain good visual comfort by selecting luminaires that reduce glare, due to their cut-off angle, and that prevent a direct view of the lamp as far as possible. Refer Figure 6 for the image showcasing the Statue of Liberty of United States, enlightened with a good visual comfort during night time.

It is vitally important that luminaires in the outdoor area also satisfy the safety requirements and this is attested by the presence of a mark of compliance with the related building rules and regulations.

LAMP TYPES

For economical lighting in outdoor areas, generally three types of lamps are used. High-pressure discharge



lamps are used where very high luminous flux, good economy and brilliant light are required. Fluorescent lamps are generally used for pathway lighting with their diffused light. LEDs are mainly chosen for quality of their long service life, compact design or various coloured lighting.

Low-voltage halogen lamps are hardly used for outdoor lighting due to their poor luminous efficacy and short service life. Modern metal halide lamps with ceramic discharge tubes boast good colour stability and rendition and feature integrated UV protection. They are available in warm white, neutral white and daylight white colours of light.

Fluorescent lamps are noted for their high luminous efficacy and long service life. The colours of light from these dimmable types of lamps are warm, neutral or daylight whites. They are

available in linear fluorescent lamp designs and as compact fluorescent lamps with a diffuse lighting effect and are suitable for applications such as uniform and economical ambient lighting on pathways.

By adopting these simple yet effective basic fundamentals of "Lighting Design for Monuments", one can achieve the perfect illumination of monuments or artworks or sculptures during night by creating orientation points for visitors that are visible from a distance moreover bringing the history and culture of the structure to light. ■



Ar. Ashish Batra
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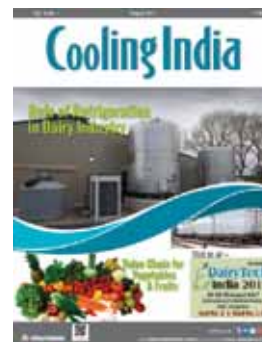
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Make your home Diwali ready with opulent chandeliers



With the festive season just around the corner, homemakers are come up with creative ways to spruce up their homes. Jaquar Lighting, the 'complete lighting solutions' brand by Jaquar Group has launched a selection of dazzling

chandeliers to make a striking statement.

Jaquar Chandeliers, a fusion of class and quality, are made with lead-free spectra and strass crystals of high-precision cut, clarity, colour, and shape, from the world's



best crystal manufacturer, Swarovski. The frame of the chandeliers is made up of pure brass which come with a 7-year warranty on the plating – ranging from 24K Gold and Rose Gold to Chrome, Antique Brass and Copper. These chandeliers

are sure to make an eye-catching addition to one's interiors. All the products in the Jaquar Lighting range offer advanced energy saving and high quality to deliver unmatched value.



NTL Lemnis launches Pharox Zen Down Lights 6W RGB

Pharox, the LED lighting brand of NTL Lemnis, launches Pharox Zen Down Lights RGB 6W across India. An ideal solution for residential and commercial lighting, the newly launched Pharox Zen Down Light RGB 6W is a recessed mounted, round, concealed down light in Red, Green and Blue colour along with the already launched in 6500K and 3000K colour.

Pharox Zen Down Lights RGB 6W comes with an integrated high efficiency driver and diffuser to give a glare free light. These Red, Green and Blue 6W Lights have a CRI of >80, a beam




angle of 120-degree and IP rating of 20.

"With Pharox, we want to be in each home and each

establishment. Witnessing the requirements for quality indoor coloured lights, we came up with Pharox Zen Down Light 6W RGB that can enhance any décor and all kinds of interiors," says Tushar Gupta, Executive Director, NTL Lemnis.

Pharox Zen Down Light 6W RGB exudes a uniform and glare free light while maintaining a high optical performance. Pharox Zen Down Light 6W RGB has a lamp life of 25,000 hours, making sure that it keeps shining brightly for a long time. Pharox Zen Down Light available at MRP of Rs 395 across India.



Jaquar Lighting sets business target of Rs 2,000 cr

The Jaquar Group has a target of achieving US\$ 1 billion in 2022 and we are expecting the lighting division should be reaching a turnover of approximately Rs 2,000 crore in 2022.

Ranbir Mehra, Director, Jaquar Lighting

Jaquar Lighting, the lighting vertical from Jaquar Group, showcased a range of complete LED lighting products at the Light India event held in New Delhi recently. In an interview with Subhajit Roy on the sidelines of the event, Jaquar Lighting's Director Ranbir Mehra and Business Head (Lighting) Mohit Sharma highlight the company's roadmap. They also inform that Jaquar is setting up 'India's biggest and most modern lighting unit' at Bhiwadi with an investment of Rs 200 crore. Excerpts:

Mr Ranbir, what is your take on the market scenario?

Ranbir: We have been seeing a positive

growth in the market for the last two and a half years now and that growth has helped us achieve our targets as well. This growth has prompted us for capacity expansion and we are coming up with a new factory in Bhiwadi, Rajasthan. Our existing LED plant is located in Manesar.

What is your current capacity and how the new capacity addition is going to help you in strengthening market presence?

Ranbir: Currently, the trade products we manufacture in-house are close to 10 lakh bulbs a month and 2 lakh patterns. This production capacity will be more

than doubled when we come up with our new plant.

We also have a driver manufacturing set-up in our existing plant at Manesar and will be setting up a similar facility even within the Bhiwadi plant.

How much have you invested in your new expansion plan?

Ranbir: We have invested around Rs 200 crore in the plant and machinery.

What is the deadline for the new plant to be operationalised?

Ranbir: Bhiwadi plant will be ready by next year end i.e. around Nov-Dec 2019.

What is the current status of the project?

Ranbir: It is in construction phase now.

With the new capacity addition, are you going to target export markets as well?

Ranbir: We will certainly target the export markets. Also, we need to obtain various certifications that are needed to enter international markets. Initially, we are planning to enter markets in Africa and UAE. In UAE, we will start with the decorative lighting and in the African market we will focus on commercial lighting.

What kind of revenue expectation you have with the enhancement of capacity?

Ranbir: The Jaquar Group has a target of achieving US\$ 1 billion in 2022 and we are expecting the lighting division should be reaching a turnover of approximately Rs 2,000 crore in 2022.

How much is it doing as of now?

Ranbir: Last year we closed at around Rs 200 crore. This year we will cross Rs 300 crore.

What will contribute to such huge growth?

Ranbir: We were present in lighting for past many years but that was a very niche segment – only in chandelier and decorative. When I joined the business two and a half years back, Mr. Mohit joined as well and we expanded the portfolio. The first year we did around Rs 100 crore and the very next year we doubled to Rs 200 crore, and in this third year we will be closing at Rs 300 crore. The 'complete lighting solutions' portfolio helped in this expansion. We have got a lot of strengths within this category and are hoping to help the market grow as well.

Suddenly, how come Jaquar Lighting has become so aggressive in the market?

Mohit: We were probably the last corporate to enter in the Indian lighting market, there are already 75 players. We are growing at CAGR of 18 per cent in last many years.

To continue growing with this momentum, we need a strong back up. We recently took Deepika Padukone as our brand ambassador for Jaquar Lighting to create a powerful brand recognition in the market. Since then we increased almost doubled our manpower over the past 2 years. To support the manpower and branding we have our in-house production capacity which we talked about. Right now, we are working on 100 per cent capacity to take care of market requirement and even materials from outside. We are already in the process of starting a new unit which is in construction in Bhiwadi. It will be India's biggest and most modern lighting unit, mostly things will be automated.



We were probably the last corporate to enter in the Indian lighting market, there are already 75 players. We are growing at CAGR of 18 per cent in last many years.

Mohit Sharma
Business Head – Lighting,
Jaquar & Company Pvt Ltd

So, you have been successful in eating others' market share as well...

Mohit: When you enter the market, you need someone's market share to make your space in the market.

Where do you see Jaquar Lighting in 5 years? What are your plans?

Ranbir: It is difficult to comment on the position as India is a great and dynamic market to work in. But we are positive that we will continue to expand our presence in India and globally.

How do you see the acceptance of 'Made in India' products?

Ranbir: 'Make in India' has been very well accepted in the market and people are ready to pay premium if the product is of that quality. For Jaquar as a group, it is very important for us to maintain that quality because we have been servicing the market for almost 60 years in the bathroom segment. We have to carry forward that same legacy of Jaquar bathroom fittings in lighting too. So, we are proud to say that, our products are 'Made in India for the world'. ■

My inspirations come from nature"



It is important to be innovative and creative and keep abreast of all that's happening around the globe.

– [Alex Davis](#), Founder, Indi Store, New Delhi

Alex Davis, a Delhi-based artist and designer, started Indi Store way back in 1999 epitomising 'India Modern' philosophy. One of the first to exhibit collections for interior and exterior spaces, today he has set a benchmark for original and contemporary design. Here, Alex talks about his lighting designing philosophy:

What is it that fascinates you about light?

The fact that something so light can fill up a large space. From when I can remember, I have loved light and light sources. Some of my earliest projects at the design school, ended up as lamps around different shaped bulbs.

My favourite genre of lighting is ambient light. The way I design lamps is that it should create a mood for the space that it put in. Its only function should be to create a mood or an ambiance. When I set up Indi Store back in 1999, I designed the cocoon lamp. This lamp got its name from the shape that it was made in. Made from pine slivers, carefully

peeled from a log and then fixed on to a pre-made structure and shaped like a cocoon. The thickness of the sliver created the quality of the light that came through it along with the gaps between each sliver. The cocoon lamp has gone through many avatars. We have them in the shape of a globe, a pendant, a post and of course the original cocoon shape. We sell them to this day and the lamp has become synonymous with Indi Store. We make them in three wood finishes: light ash, walnut and dark wood. We also make them in natural steel and stainless steel in 4 different finishes: gold, silver, copper and gun metal. Besides the cocoon, we have some beautiful lamps: The Luna, The Kudu - inspired from the Kudu of Africa, Woody, Chrysanthemum, Column, Monsoon, Patchwork and the latest in burnt wood and metal - Carbon.

What's your lighting designing philosophy?

Lighting design has always interested me. My philosophy is very simple...my lights should look sculptural when they are switched on or off. My approach to everything I design has been that: It is an art with a purpose or function. My inspirations come from nature and what I see around me. The designs are simple and not fussy. When I conceive an idea for a lamp, its sole purpose is to decorate and create interest when it is switched on or off. I have excellent artisans who make every piece by hand and that adds a 'human-ness' to every product in the store. It makes the space feel warm even when the light is turned off.

What makes a great piece of lighting solution?

Depending on the purpose that the light has to perform, lights and lighting



should be designed. If one manages to fill that criteria, then the solution is perfect. We work on different projects where we design lights for a particular requirement. Sometimes, it is to light up offices and at others it could be to create atmosphere in a home... sometimes it is an interesting chandelier at others it is a sculpture. I recently did an installation for Swarovski. It was called Deepa and was a 22-foot high sculpture. This had no light in it but drew its inspiration from the flame from a diya. The sculpture was an ode to Diwali.

Lighting technology is changing very fast. How do you keep pace with technology?

One reads and sees what is available in the market. It's always an interesting challenge to design lights using the latest that is available. The shape of the bulbs, the type of light and the purpose it has to fulfil, become the brief for a perfect lighting solution. One of my latest lamps is called Monsoon. It is like a rain drops made in metal wherein some have a tiny light source and some don't. This is possible due to the size of

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the LED bulbs available. Then there are bulbs which are so beautiful in themselves, that it isn't important to cover them with a shade.

What are the current challenges of working with LED technology?

The only problem I have with the LED lights is that the drivers get spoilt very fast. We need to improve that as that can be pretty irritating as the bulbs blow out very fast. We have used a lot of LED bulbs in our store. Each time one bulb blows out, it takes a lot of effort to change them. Since these are more expensive than regular lights, it would be great if they were also more reliable.

What's your greatest achievement?

The fact that I am able to do what I love and there are people out there who appreciate what I do.

I did my mechanical engineering from Mysore university and followed it up with a PG in product design from the National Institute of Design, Ahmedabad. This was followed by a masters in industrial design from Domus Academy, Milano. I worked for Alessi before I came back to India. In my initial working years, I did a lot of interior design and furniture design for offices and homes. I needed something more to make me happy and keep me satisfied with my

work. In 1999, I decided to open my own store so as to showcase my creativity. I designed and manufactured everything that I kept in the store. My philosophy was India Modern...I wanted to and still like to keep it contemporary with a timeless quality to everything that I make. At the time I launched Indi Store, there weren't too many contemporary furniture stores in India. I continue to design for clients and we customise everything that we have as per a client's requirement. Our pieces continue to be handmade keeping it real always. I work with a lot of stainless-steel, natural steel, brass and copper, besides wood and beautiful veneers from all around the world. I wanted to use something as industrial as stainless-steel sheets and pipes and convert them into pieces of art. I launched my first collection of 35 products in 2004, called 'I went fishing'. This collection also had lights in them. Since then I have done 5 other collections and 3 of those have unique handmade lamps.

What's your message for all budding lighting designers?

Understand your brief correctly and deliver the best possible design solution. It is important to be innovative and creative and keep abreast of all that's happening around the globe. ■





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Efficient & tough

RLE-G2 modules for reliable industrial and outdoor lighting

The new RLE G2 modules for industrial and outdoor lighting are versatile and offer high efficiency and reliability even in harsh conditions.



The new RLE-G2 modules from Tridonic have been developed for harsh industrial environments and challenging outdoor conditions. They are designed to withstand salt spray, pollutants and extreme temperatures and are easy to integrate in a very wide range of luminaires. With their long life and high efficiency, they cover a broad spectrum of potential applications.

The second generation of the RLE EXC and ADV family of modules for industrial and outdoor lighting has been specifically developed for modular luminaire designs. All the high-power and mid-power modules have passed a demanding series of tests, including exposure to salt spray and pollutants. With their extended temperature range of (-) 40-degree C to (+) 105-degree C / (+) 95-degree C (high power/mid power) they can also handle

extreme climatic conditions.

"While high-power modules are extremely durable with a life of 100,000 hours, mid-power modules offer exceptionally high efficiency of up to 190 lm/W and a life of 80,000 hours," the manufacturer claims. "Together with a suitable Tridonic outdoor driver, all the RLE G2 modules can withstand surge and burst voltages of up to 6 kV. The modules comply with the ZHAGA standard and are compatible with various standard lenses available on the market."

EXC HIGH-POWER MODULES

The RLE 2x4 / 2x8 EXC2 OTD modules are equipped with 2 x 4 or 2 x 8 high-power LEDs and achieve a luminous flux of 2,000 and 4,000 lm respectively. Their module efficiency is up to 170 lm/W at

550 mA (nominal operation). The LED modules are available in different colour temperatures: 2,700 K, 3,000 K, 4,000 K and 5,000 K with a CRI > 80, and 4,000 K and 6,500 K with a CRI > 70. CRI > 70 stands for high efficiency, and CRI > 80 for good colour rendering. They are compatible with standard 2x2 lenses, such as LEDIL Strada 2x2.

The RLE 2x6 EXC2 OTD modules with 2 x 6 high-power LEDs achieve a luminous flux of 3,000 lm and a module efficiency of up to 140 lm/W at 700 mA (nominal operation). The cost-effective modules can also be operated without protective glass. They are suitable for standard IP6x lenses, such as LEDIL Strada IP-2x6.

ADV MID-POWER MODULES

The RLE ADV2 OTD modules have 32 or 64 mid-power LEDs on the board and achieve 2,000 and 4,000 lm respectively. They are impressive for their extraordinary efficiency of up to 190 lm/W at 500 mA (nominal operation) and provide more homogeneous light and less glare than high-power LEDs. Standard x16 lenses such as LEDIL Stradella 16 are suitable here. The modules can be used without protective glass.

The manufacturer offers a warranty of 8 years on the high-power modules with a life of 100,000 hours, and a warranty of 5 years on the mid-power modules with a life of 80,000 hours. ■

For more details, visit www.tridonic.com

“100 airports in next 15 years; big opportunity for lighting industry”



(Left) Commerce & Industry Minister Suresh Prabhu delivering inaugural address at the Light India 2018 exhibition in Delhi. (Right) Science & Technology Minister Dr Harsh Vardhan inaugurating the event.

“We will build 100 airports in the next 15 years and for that we have experts and an investment of US\$ 65 billion for this industry. This will be a big opportunity for the lighting industry,” promises Commerce & Industry Minister Suresh Prabhu while inaugurating the Light India 2018 exhibition in Delhi.

He further added, “This is a great occasion where excellent brands have displayed their products in the fast-

growing lighting industry. We promise to provide full support for the exports of these products and encourage the exhibitors to have more manufacturing not only for the domestic but also for the global markets. While we ensure environment friendly lights aesthetics will be equally important so the industry has an opportunity of providing innovative solutions. We want the industry to manufacture in India not



just for Indian markets but for global markets.”

India is all decked up to emerge as the largest market for lighting systems, especially the LED segment, as a lot has changed in the last four years. According to Sunil Sikka, Advisor, ELCOMA, “LED lights in India are sold below Rs 50 and this month the domestic production of LED lights has crossed one billion. Almost 12 per cent of all LED lighting systems sold all over the world is consumed by India alone.”

Bridging the gap between global industry giants and the serious buyers, Messe Frankfurt recently organised Light India 2018 and Electrical Building Technology 2018 (EBTI) in association with Electric Lamp and Component Manufacturers (ELCOMA). The event held in Delhi brought together 193 exhibitors from India, China, Hong Kong and the UAE.

Continuing the enthusiasm Science & Technology Minister Dr Harsh Vardhan said, “We have discussed Light India and the industry’s role as to how the stakeholders have helped us reduce the price of LED lights from Rs 380 to Rs 250.”

Standing out as a market having immense potential, India has gained the attention from many global investors and business leaders in the lighting and electrical building industry. The top-notch domestic and international leaders from lighting, building and automation market have participated in the 3-day exhibition seizing business opportunities and preparing the Indian market for a smart and tech-ready transformation in lights and building automation systems.

PRODUCT HIGHLIGHTS

- India ‘s first 5-Star LED bulb that is

low-glare, fixture-free and 30% brighter than 3-Star LED by Orient Electric

- Jaquar introduced its latest copper chandelier finely crafted with silver plating that is equipped with intelligent lighting features which pull through the fluctuations of high/low voltage and high/low temperature.
- WiFi connected lights that can be grouped together and are operated through the Ecoearth neo mobile app by Neo Ecoearth.
- A range of smart lights that includes panel lights, street light T8 sensor tube light and LED solar street light with reflectors with dimming, delay time and many other functions by Chatur Lights.
- LED downlight (architectural) can be used in offices, shops, exhibition halls, hotels, restaurants, cafes, malls, as it is eye friendly, long lasting, eco-friendly, non-hazardous and has a life of 15,000 hours by ERO Global.
- 2x2 cleanroom fitting (bottom and top opening) that is eco-friendly and can be used in high IP class Pryotech.
- Covestro unveils range of polycarbonate resins and blends, along with application support, for designers and manufacturers in the LED lighting industry that can be used for LED lenses, diffusers, reflectors, and housings.
- App operated smart lights that includes bulb, downlights and striplights that give a full spectrum of palette of 16 million colours by Svarochi.



Skim downlights for track from ERCO

Specifically, for the needs of today's dynamic worlds of work, a new, unique class of lighting tools has been developed in the form of Skim downlights for track – as flexible as spotlights and as simple and efficient as downlights. Using the tried-and-trusted LED lens optics from the Skim range, they feature high levels of visual comfort optimised according to the application and enable the lighting to be adapted at any time to changing office structures or layouts.

Work in offices is changing and with it the design of corresponding rooms and

workstations. Key terms such as desk-sharing and co-working point the way: fixed concepts and structures belong to the past and modern offices score with high levels of flexibility and diversely designed work environments. Zones for various uses, ranging from concentrated individual work to creative teamwork, productive meetings and relaxing breaks, also need to differ in their atmosphere. Such new demands can only be fulfilled with equally innovative approaches in terms of lighting. ERCO has achieved this with the new Skim downlight for track that



Image: © ERCO GmbH

brings together the benefits of spotlights and downlights.

A NEW CLASS OF LIGHTING TOOLS

The first thing noticed is the unmistakably smooth design, enabling these new types of luminaires to blend into highly diverse interiors in the form of technical details. The flat cast

aluminium housing accommodates two LED lens optics that are characteristic for the Skim range. The luminaire is on an ERCO track adapter which is rotatable through 360-degree, enabling flexible positioning to suitable track. In this way the luminaires offer the neat appearance and visual comfort of downlight illumination without the complexity of recessing into ceilings. Added to this is the freedom to reconfigure the lighting at any time if the office layout or room use changes. ■

Source: www.erco.com

Brighter, more flexible tower light now available from Rockwell Automation



Rockwell Automation introduces the Allen-Bradley ControlTower 856T 70 mm Tower Light system. This new system incorporates brighter LED illumination and a broad offering of visual and sound technologies all in a 70 mm diameter housing. The ControlTower 856T is capable of accommodating up to seven modules in the

same stack, offering users the ability to monitor more machine and process conditions in a single device.

This new modular design allows the ControlTower 856T system to meet the widest range of signalling applications with a reduced number of components.

LED on a roll



The flexible LLE FLEX IP67 EXCITE continuous row from Tridonic offers protections from dust and water and can be installed in moisture-prone rooms, like

bathrooms, without a second thought. A stable colour temperature without any chromacity coordinate shift also allows for combination with other continuous rows.

The dimmable 24 V constant voltage continuous row with 6 mm light point intervals produces impressively homogeneous light. Tridonic avoids chromacity coordinate shift, which would otherwise be typical for such a high degree of protection, by using innovative airGAP technology in the manufacturing process. The IP67 continuous row is especially suitable for applications that call for high lighting quality in addition to a high degree of protection. The colour rendering index in all versions of the LLE FLEX IP67 EXCITE is higher than 90, and module efficiency boasts up to 100 lm/W.

Vishay Intertechnology launches high power, high current mica grid resistors



Vishay Intertechnology, Inc. introduced a new series of high power, high current mica grid resistors in the standard mill bank size. Offering designers a lower cost option to the standard stainless steel grid design, Vishay Milwaukee GREM resistors feature EDG technology for improvements in power capacity, weight, and watt density, while maintaining the same package size.

The devices released feature power of 8 kW at 40-degree C,

which is 23 per cent higher than standard 6,500 W stainless steel grid resistors in the standard mill bank size. At the same time, GREM devices are 30 per cent lighter than stainless steel grid resistors with the same power dissipation, and offer a favourable price point. These specifications make the devices ideal for load banks, dynamic braking, and motor control in low vibration industrial and alternative energy applications.

GREM resistors feature a resistance range from 0.067 Ω to 24.273 Ω , with a tolerance of (\pm) 10 per cent, temperature coefficients down (\pm) 130 ppm/degree C, and currents from 18 A to 345 A. The devices offer high temperature operation to (+) 415-degree C.

Vishay Intertechnology, Inc., a Fortune 1000 Company listed on the NYSE (VSH), is one of the world's largest manufacturers of discrete semiconductors (diodes, MOSFETs, and infrared optoelectronics) and passive electronic components (resistors, inductors, and capacitors). These components are used in virtually all types of electronic devices and equipment, in the industrial, computing, automotive, consumer, telecommunications, military, aerospace, power supplies, and medical markets.

Event Calendar

@Home World Expo

Venue: Bombay Exhibition Centre, Mumbai
Date: 22 - 24 November 2018
Website: www.athomeworldexpo.com

LED Expo, Delhi

Venue: India Exposition Mart Ltd. Greater Noida, Delhi
Date: 6 - 8 December 2018
Website: www.theledexpo.com

LED China 2019

Venue: Shenzhen Convention & Exhibition Center
Date: 21 - 23 February 2019
Website: www.ledchina-sh.com

Strategies in Light 2019

Venue: Mandalay Bay Convention Center, Las Vegas
Date: 27 February - 1 March 2019
Website: www.strategiesinlight.com

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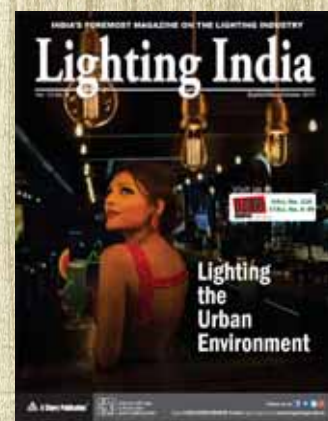
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