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LEDs MAGAZINE

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Issue 6 April 2006

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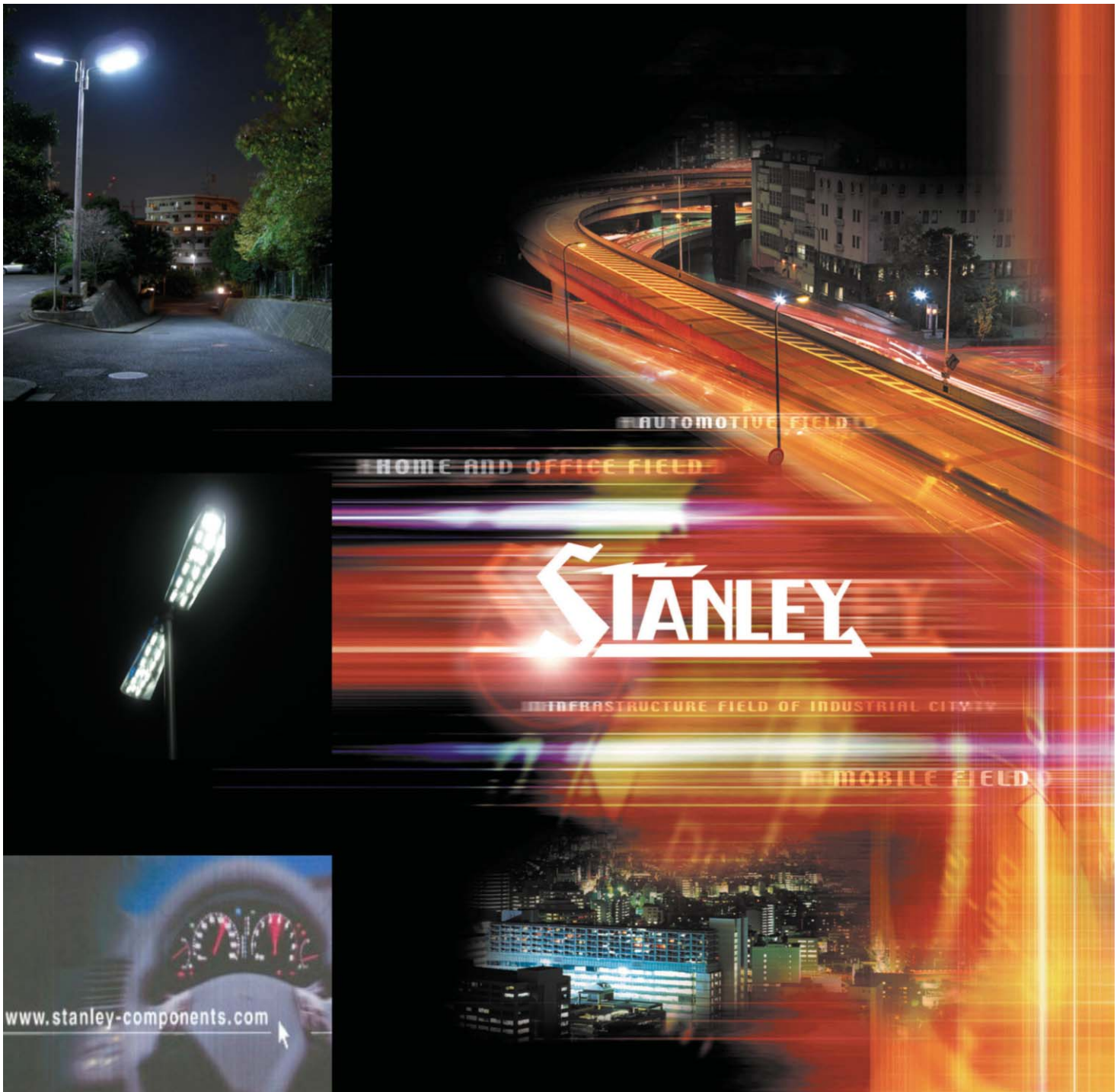

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Each month a number of articles are published on the *LEDs Magazine* website (see www.ledsmagazine.com/articles/features).

PACKAGING

Silicone materials development for LED packaging
The properties of silicone materials make them ideal for new, demanding applications, such as protective encapsulants and lenses for high-brightness, LEDs according to an article by Dow Corning.

RETAIL ILLUMINATION

LED luminaires get warm welcome in supermarket freezers
An emerging application for LED luminaires is to provide illumination in temperature-controlled retail cases used in supermarkets for the display of perishable goods.

BACKLIGHTING

Articulated Light-Sheet provides flexible lighting
A manufacturing process for embedding LEDs within conductive substrates enables long-lasting and durable solid-state lighting sources.

ARCHITECTURAL LIGHTING

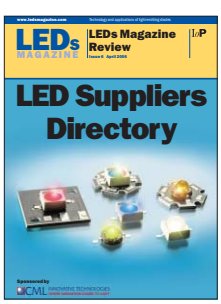
LEDs illuminate Brunel's bridge
LED lighting features prominently in the new lighting scheme for the Clifton Suspension Bridge.

COMPANY PROFILE

OPTEK Technology: bringing LED designs to light
TT electronics OPTEK Technology offers design engineers an integrated source of visible LED products for solid-state lighting applications.

ARCHITECTURAL LIGHTING

Flying high in Malmö: LEDs light up in the Turning Torso
An innovative white LED lighting scheme has been incorporated into Europe's tallest residential building.



On the cover: *CML Innovative Technologies is one of the largest suppliers of miniature lighting components and systems* **p20**

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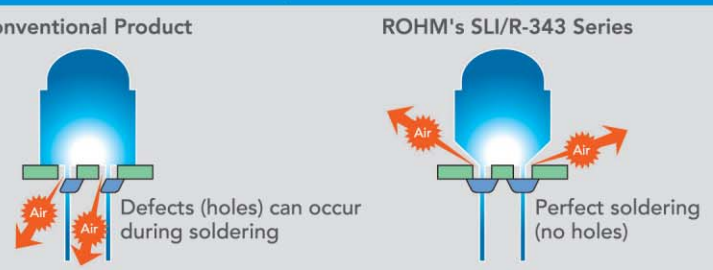
Light it. with Ultra High Bright LEDs

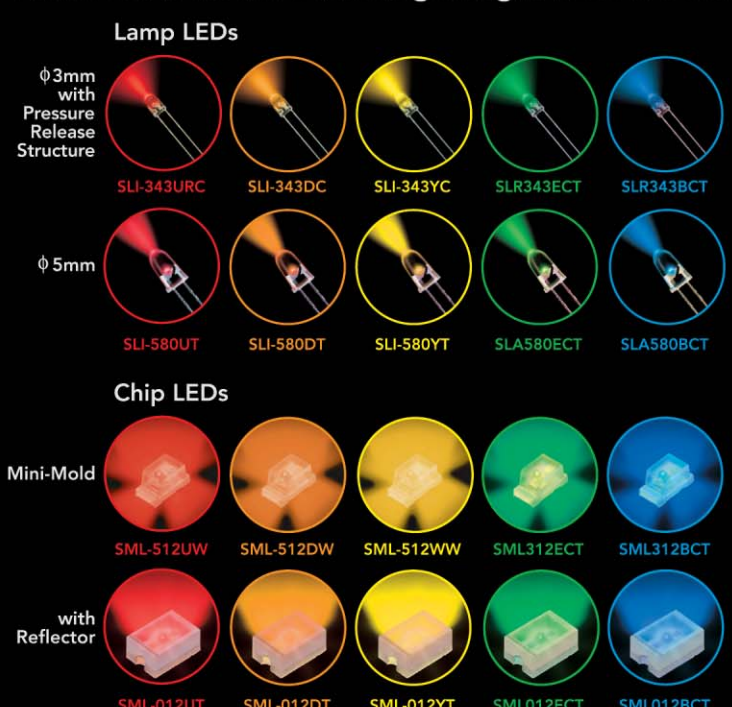
The Only LED Lamps with a Pressure Release Structure (SLI / R-343 Series).

No Retouch Soldering

ROHM's pressure release structure prevents pressure build-up during the soldering process when the LED is mounted on the PCB.



Pick a color. ROHM's ultra high bright LEDs are available in many luminous colors.



Wide Directivity

ROHM's ϕ3mm LEDs feature a directivity equivalent to that of ϕ5mm LEDs (luminous intensity half-power viewing angle approximately 40°).

Many Luminous Colors

ROHM offers an LED lineup in a variety of luminous colors using both AlGaInP (a proprietary compound) and InGaN.

A Broad Lineup of LEDs

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- Reverse mount chip LEDs
- Low current chip LEDs (ideal for portables)
- Dual color chip LEDs
- LED lamps with pressure release structure
- Direct mount LED lamps

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LCD display backlighting and illumination markets drive HB-LED demand

The market for high-brightness LEDs is expected to double between 2005 and 2010 and there will be a significant change in the leading applications, according to **Bob Steele** of Strategies Unlimited.

As in recent years, the dominant application for high-brightness (HB) LEDs in 2005 was mobile appliances (figure 1). This category includes both mobile phones and other portable electronic products, such as digital cameras, PDAs, MP3 players and hand-held game players.

Although mobile appliances accounted for more than half of the total market of $4.0 billion in 2005, this represented a lower market share than in 2004 (all market figures relate to sales of packaged HB-LED devices). During last year the use of HB-LEDs for display and keypad backlights began to saturate, and prices declined dramatically, especially for keypad backlights, owing to excess production capacity in Asia.

In spite of the stagnation of the mobile appliance market in 2005, other applications continued along the growth path of recent years, with overall growth of all applications other than mobile appliances estimated at 21%. This growth was led by the illumination category, which grew by more than 40%.

In the next five years the growth rates among the various applications will differ dramatically, so the application break-out in 2010 will look quite different from that in 2005 (figure 2).

In 2010 the contribution from mobile appliances will decline to just 28%. Overall this market is expected to remain flat. The market for HB-LEDs in mobile phones is in fact forecast to decline substantially, owing to saturation, price declines and the increasing penetration of OLED displays.

However, the use of white LEDs for backlighting small full-color LCD displays in digital cameras, MP3 players and hand-held game players – all of which are experiencing rapid unit growth – will help to sustain the market. In addition, white LED backlights for notebook computers, which first began to appear in 2005, will make a substantial contribution.

The most significant changes in market share will be in the signs/displays and illumination categories. The signs/displays category includes not only large LED text messaging and full-color video screens but also LED backlights for LCD monitors and TVs.

While this latter application was just in its beginning stages in 2005, rapid growth is expected in the next five years, with even modest penetration of the large projected LCD monitor and TV markets (more

HB-LED market by application in 2005

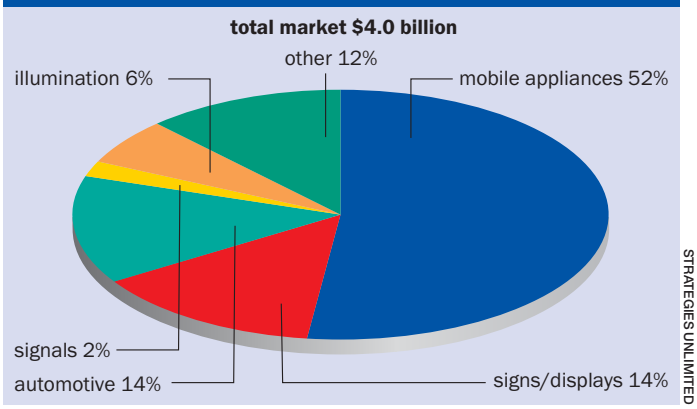

Fig. 1. As in previous years, mobile appliances was the dominant HB-LED category in 2005, but with a reduced market share.

HB-LED market by application in 2010

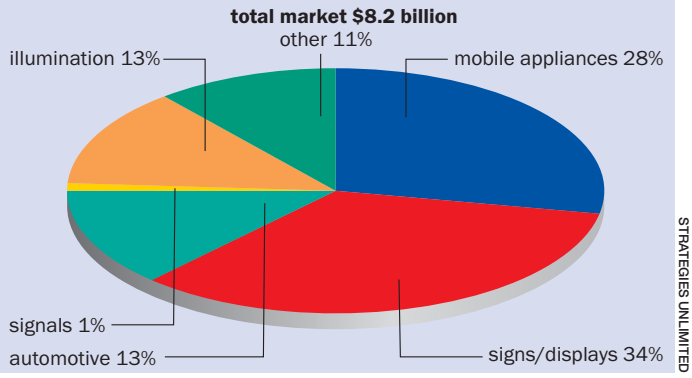

Fig. 2. In 2010, Signs/Displays will become the largest market segment, with Illumination also showing strong growth.

HB-LED market by package type in 2005

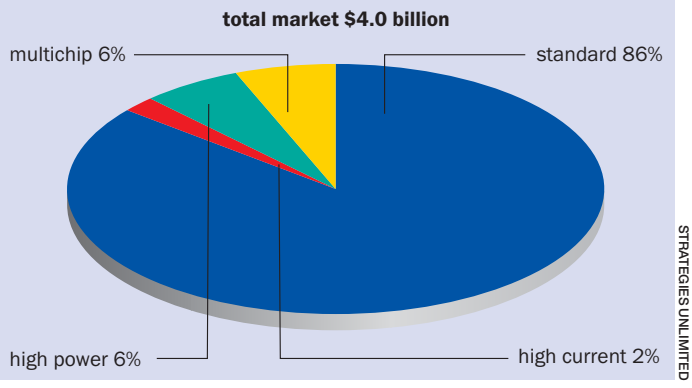

Fig. 3. Most LEDs use standard packages, but the fastest-growing category in the next five years will be high-power LED packages.

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than 180 million monitors and more than 90 million TVs) making a significant impact on the HB-LED market in 2010.

Penetration of the general lighting market is the "Holy Grail" of the HB-LED industry, and by 2010 this penetration will be well under way. Although most of the lighting applications being addressed in 2010 will continue to be specialty or niche applications, many of them for colored lighting, there will also be a growing number of white-light applications in the retail display, commercial building and even residential markets. These will be driven by continuing improvements in white LED luminous efficacy (lumens/watt), as well as concomitant decreases in dollars per lumen and the development of user-friendly integrated LED luminaires.

Although the market share for automotive applications (including both interior and exterior lighting) does not show an increase from 2005 to 2010, large market growth will still take place. To a large extent this will be driven by the use of white LEDs for headlamps, which are expected to enter the market for the first time in late 2007.

As figure 3 shows, the 2005 HB-LED market continued to be dominated by products that use standard LED packages – either traditional lamp packages (e.g. 3 mm, 5 mm) or various SMD configurations (e.g. topview, sideview, PLCC). Standard packages are widely use in mobile phones, LED text messaging and full-color video screens, automotive interior lighting, and some specialty lighting applications.

High-current LEDs (i.e. those that have drive currents that are much higher than the standard 20 mA) are used primarily in automotive signaling, but also in various illumination applications, such as channel letters and machine vision. Multichip packages, typically consisting of one red, one green and one blue chip in the same package to achieve multiple colors, are used mainly in ringer lights for mobile phones, but increasingly in small-pitch (<10 mm) full-color video screens.

The fastest-growing product type in the next five years will be high-power LEDs. These have input powers in the 0.5–5 W range and outputs ranging from tens of lumens to more than 100 lm. These devices use large-area chips and special packaging for thermal management. Their largest use currently is in illumination applications, with significant use also in traffic signals and flashlamps for camera phones. In addition to illumination, major future growth areas will be in backlights for LCD monitors and TVs, and automotive forward lighting.

About the author

Robert V Steele is director of Optoelectronics at Strategies Unlimited (www.strategies-u.com), a 27-year-old market research firm based in Mountain View, California. He is responsible for all of the company's activities in high-brightness LEDs and solid-state lighting, and is also the chair of the annual Strategies in Light conference on high-brightness LEDs.

Solid-state lighting presents challenges for LED and OLED technologies

Solid-state lighting is a viable option for the lighting industry, but there are a number of hurdles that need to be overcome, according to **Ashwini Meena** of Frost & Sullivan.

Rapid innovations and developments in the lighting industry, coupled with the importance of energy savings and environmental friendliness, have encouraged the lighting industry to look for an alternative for the basic light source, which has been around for more than 100 years – the incandescent bulb.

Solid-state lighting (SSL) has nothing in common with the bulb other than the purpose of illumination. Even though solid-state technology has been around for more than four decades, extensive research and innovations in the last few years have unveiled SSL's true potential and its ability to change the landscape of the lighting industry.

The low efficiency of existing light sources, combined with their limitations in design, drive the need for an innovative solution, and SSL is emerging as a viable option. However, more improvement on the levels of light output and color quality, along with a reduction in the initial cost, are necessary to enable it to make a significant impact on the lighting industry.

LEDs are already being used in applications where upfront cost is not the major issue, such as traffic signal lights and camera flashes.

Organic LEDs (OLEDs) are a new breed of SSL, combining some of the performance characteristics of LEDs with additional features, such as thinness, transparency and flexibility. Further, OLED technology opens up the possibility of many innovative new applications, such as a dual functional window, which remains transparent in the daytime and functions as a light source at night.

OLEDs have already demonstrated commercial feasibility via the introduction of products for flat-panel displays in mobile applications. The intrinsic features and strong potential of OLEDs – thin modules, large illumination areas and low power consumption, among others – make this technology a prime candidate for future lighting applications. However, there are some challenges yet to be addressed, such as moisture sensitivity and outcoupling (figure 4).

The LED industry, with its promising future and fierce market competition, has been showing tremendous progress in recent years. Some of the key challenges that have to be addressed are high cost, patent-infringement issues and thermal management (figure 5).

The research focus on OLED and LED technologies is likely to shift toward factors such as new materials and production techniques, which will contribute to reduced costs. One of the major drivers for SSL R&D is the immense investments by both government and corporate bodies, such as the Next-Generation Lighting Initiative (NGLI) in the US, Europe's Organic LEDs for ICT and Lighting Applications (OLLA) and Japan's Light for the 21st Century project.

The LED industry is focused on the development of more compact

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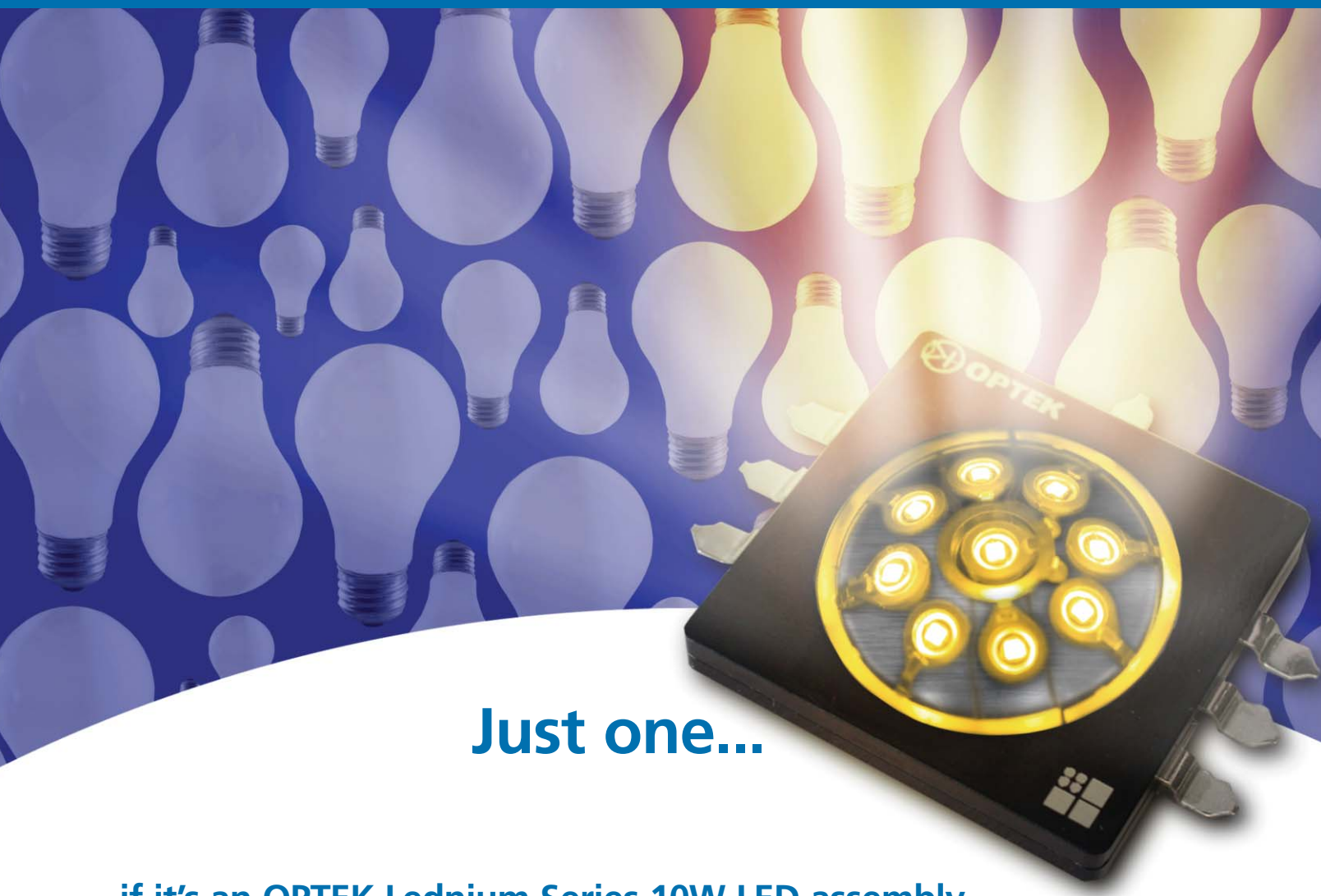
How many LEDs does it take to change a light bulb?



Just one...

...if it's an OPTEK Lednium Series 10W LED assembly.

OPTEK Technology replaces conventional ideas about lighting technology with its Lednium Series: An exceptionally bright 10-watt, 9-LED assembly that provides up to 330 lumens of light output in a compact surface mount package that measures just 1.3" x 1.3" x 0.5" high. The energy-efficient design of OPTEK's Lednium Series devices features a three-dimensional domed lead-frame that offers a 120° viewing angle and low thermal resistance that enables full-power LED operation with long lifespan.

OPTEK's Lednium Series LED assemblies are available in red, amber, green, blue, white and RGB color configurations for all types of interior and exterior lighting in automotive applications, architectural lighting fixtures, and electronic signage, traffic signals and electronic displays.

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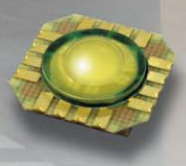


CL-652S Series

Characteristics

Reference

■ Electro-optical Characteristics

〈Cool White:CL-652S-8WN-SD〉

Condition	Item	Min	Typ	Max	Unit
Ta=25℃ IFDC=44mA (8-chips in Serial)	Forward voltage	-	28	-	V
	Luminous intensity	-	28	-	cd
	Luminous flux	-	85	-	lm
	Chromaticity coordinate Typ.	x, y=0.31, 0.32			

NOTE For 8-chips in Parallel connection, IFDC= 350mA, Forward Voltage = 3.5V

〈Warm White:CL-652S-8LTN-SD〉

Condition	Item	Min	Typ	Max	Unit
Ta=25℃ IFDC=44mA (8-chips in Serial)	Forward voltage	-	28	-	V
	Luminous intensity	-	19	-	cd
	Luminous flux	-	59	-	lm
	Chromaticity coordinate Typ.	x, y=0.43, 0.40			

NOTE For 8-chips in Parallel connection, IFDC= 350mA, Forward Voltage = 3.5V

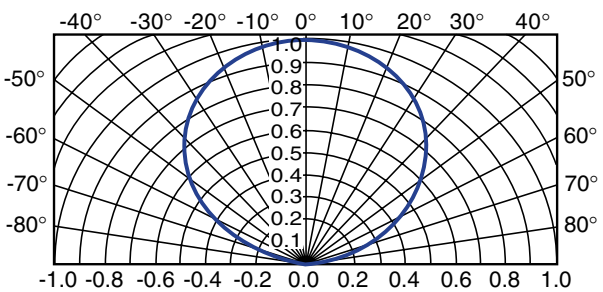
■ Absolute Maximum Rating (Ta=25℃)

Item	Rating	Unit	Remarks
Power dissipation	2.0	W	
Forward current	60	mA	8-chips serial connection
Pulse forward current	100*	mA	8-chips serial connection
Reverse voltage	5	V	At 1-chip
Operating temperature range	-25～+80	℃	
Storage temperature range	-30～+85	℃	
Junction temperature	120	℃	

*Duty≦1/10, Pulse width≦10msec

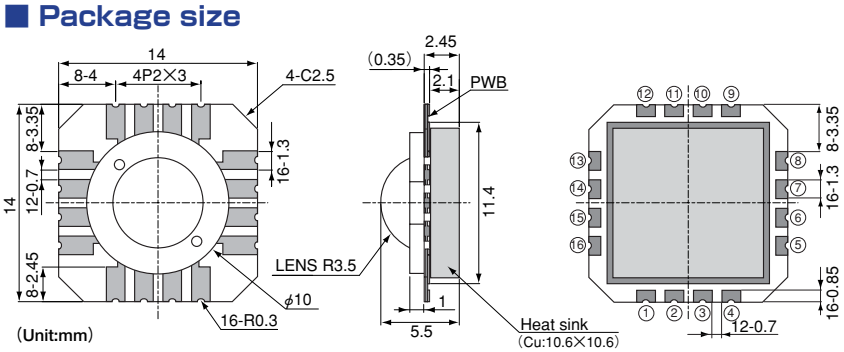
NOTE For 8-chips in Parallel connection, Forward current = 480mA, Pulse forward current = 800mA

■ Directivity

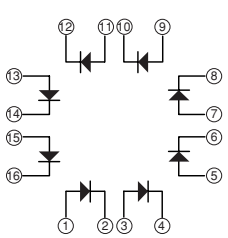


Define a central axis of a product as θ=℃

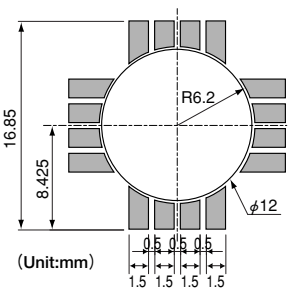
■ Package size



■ Internal circuit



■ Recommended soldering pattern



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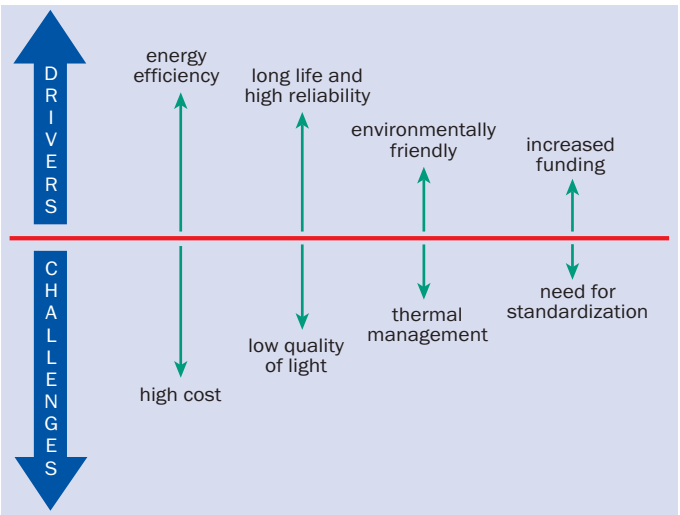

Fig. 4. LED technology drivers and challenges.

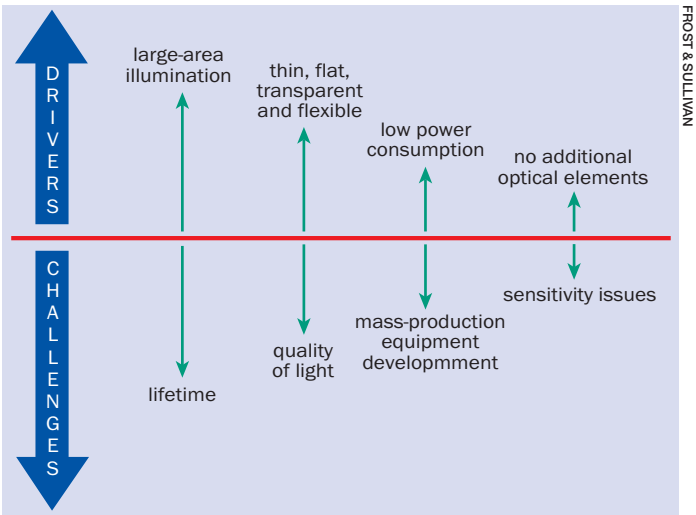

Fig. 5. OLED technology drivers and challenges.

LEDs. On the other hand, it is also focusing on the development of high-power LEDs with large dimensions. Still, SSL is more than an enchantment to the lighting industry, very much evident by the involvement of lighting giants like Philips, Osram and General Electric.

Solid-state lighting technology is becoming the most important trend in the lighting industry, and it will be even more important in the next four to five years as LED and OLED technologies make further progress. Though there are a few challenges left to overcome, SSL has the potential to substitute for existing light sources in a few years' time.

About the author

Ms Ashwini Meena is a research analyst with Frost & Sullivan (www.ti.frost.com). This article is based on Frost & Sullivan's latest research, entitled "Emerging lighting systems - a technology analysis" D389. For further information, contact magdalena.oberland@frost.com.

LED driver market emphasizes high-power requirements

Demand for LED drivers will grow at an average annual rate of almost 15%, according to **Linnea Brush** of Darnell Group.

Originally introduced as simple indicator lights, the more recent discovery and emergence of high-brightness LEDs has taken the industry by storm. They are now expected to gain even greater market share in a number of different application segments.

Although their use spreads across a variety of segments and applications, for the purposes of this analysis we have studied signaling, signage, illumination and automotive. The latter segment includes only signaling, tail-lamps and headlamps.

Each of these applications uses drivers to provide the power needed for the LEDs. The forecasts are for the number of drivers, not LEDs, because each application can incorporate hundreds of emitters.

Figure 6 shows shipments of LED drivers according to power supplied. The >15 W segment is largely driven by signage applications Large-format scrolling and animated LED signs have recently emerged that can consume upwards of several hundred watts of power. The >15 W segment is the largest, with driver sales of 157.4 million units in 2005. Shipments will grow at an annual average rate of 14.1%, reaching 303.9 million units by 2010.

Worldwide LED driver shipments (million units)

Power	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*CAGR*
<6 W	40.8	48.5	57.3	67.6	79.7	94.4	18.2%
6–15 W	14.1	15.7	17.6	20	22.8	26.1	13.1%
>15 W	157.4	184.3	212.1	240.5	270.3	303.9	14.1%
Total	212.4	248.5	287.1	328.1	372.8	424.4	14.9%

Fig. 6. Driven by signage applications, the >15 W driver segment is the largest but the <6 W segment will experience the most rapid growth in the next several years. (Courtesy of Darnell Group.)

Most signaling applications fall within the 6–15 W segment. These are largely responsible for shipments of 14.1 million units in 2005.

Meanwhile the <6 W segment consists of a variety of uses, ranging from certain automotive applications to exit signs. This segment is forecast to grow at an average annual rate of 18.2%, from sales of 40.8 million units in 2005 to 94.4 million units in 2010.

Two major hurdles standing before widespread adoption of LEDs are lumens and price. Before LEDs can be used in many applications, the technology must produce light that is bright enough to merit its

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use. In addition, LEDs must be produced at a price that is reasonable and competitive with alternative products. The success of LEDs will depend on price as much as performance. Consumers have proved that, despite long-term or lifetime savings, they are unwilling to pay exceedingly high initial costs.

About the author

Linnea Brush is a senior analyst with Darnell Group Inc (www.darnell.com). This article is based on a report entitled "Global electronic ballast markets: technologies, applications, trends and competitive environment", 4th edn, published by Darnell.

Automotive market presents many opportunities for HB-LEDs

LEDs have strong market potential in cars, offering improved safety and better design, says **Eric Mounier** of Yole Développement.

The use of HB-LEDs for automotive applications is currently a very hot research and development topic, with the objective of decreasing price while increasing performance. LEDs have very strong market opportunities in the automobile as they can be used for front and rear lighting, as well as for interior lighting.

For automotive applications the main advantages of LEDs are:

- they are environmentally friendly, containing no mercury and having low power consumption;
- they have a long lifetime of 10 000 h compared with the 3000 h minimum expected lifetime for incandescent bulbs;
- they bring improved safety: they have a fast reaction time and light up around 250 ms quicker than incandescent bulbs (at a speed of 100 km/h, that represents a gain of 7 m in braking distance).

LEDs can be used for both internal and external lighting. The HB-LED market for interior lighting is the largest of the two segments, while the external lighting segment will have the highest growth rate. Figure 7 shows the 2009 market forecast for LEDs in cars, which will have a total value of $800 million.

External lighting will represent 40% of the total for automotive applications in 2009, or well in excess of $300 million. The external LED lighting market will grow by 72% between 2003 and 2009, mainly driven by the introduction of white HB-LEDs for forward lighting. In contrast, the HB-LED market for interior lighting will have only a 5% growth rate.

The market for LEDs in front lighting is just beginning. Although the first LED-based front lights (specifically LED-based daytime running lights) appeared in 2004 on high-end cars, the market will really take off in 2008.

There are, of course, some drawbacks to the use of LEDs for external lighting. First, regulations must be updated, particularly in Europe, to allow LEDs to be used in all external applications, including front lighting. Second, the cost in lumens per dollar is still too high. Figure 8 shows the current best commercially available performances and prices for HB-LEDs, together with the cost objective that would permit widespread use throughout the automotive market. The cost objective for automotive is likely to be reached in 2010–2012, and by this time LEDs will be the dominant light source for external lighting.

Despite the difficulties, many players have announced prototypes and preseries for front lighting based on white HB-LEDs. To name a few: Audi has announced that the Audi A8 will have LED-based front light with luminous performances competing with xenon in 2008; Hella is collaborating with Volkswagen to commercialize an LED-based front lighting system with a 1000 lm output in 2008; and, in the US, Visteon and General Motors have disclosed that they are developing LED-based lighting.

HB-LED automotive market in 2009

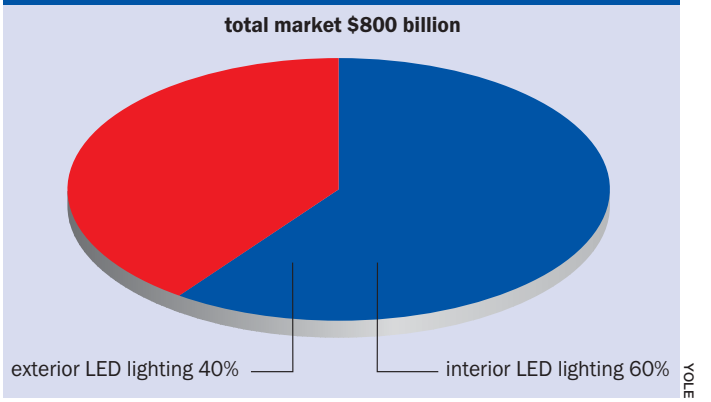

Fig. 7. LEDs in interior and exterior automotive lighting.

Automotive requirements for LEDs

Color	*2004 lumen cost (lm/$)*	*Cost objective for automotive market*
red (633 nm)	20 lm/$	50 lm/$
amber (617 nm)	30 lm/$	60 lm/$
white	about 17 lm/$	100–150 lm/$

Fig. 8. Commercially available performance and price comparison for HB-LEDs, together with cost objectives for the car industry.

About the author

Eric Mounier (e-mail: mounier@yole.fr) is project manager in MEMS and optoelectronics at Yole Développement (www.yole.fr). He is also editor-in-chief of Micronews.This article is based on Yole Développement's "LED2Light" report. For more details, e-mail: David Jourdan at jourdan@yole.fr.

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LEDs MAGAZINE

Standardization requirements and safety concerns drive LED test and measurement developments

As measurements and standards catch up with the explosive development of LEDs, the UK's National Physical Laboratory is well placed to advise on best practice, and to carry out accurate and traceable measurements, say **Paul Miller**, **Teresa Goodman** and **Simon Hall**.

The rapid rate at which LEDs have entered and become ubiquitous in lighting has presented industry, R&D and regulatory bodies with several measurement challenges. LEDs are already replacing incandescent lighting in many scenarios and are currently being developed for specialized applications such as combined brake and indicator lights in the automotive industry. They are also being used in more safety-critical areas, including railway signalling and medical phototherapy.

LEDs now come in a variety of wavelengths (UV through the visible to IR), brightness values (e.g. 140 lm flux from a single green LED produced by Lumileds) and formats (single packaged LEDs; multiple LEDs in clusters; and even novel technology including LED backlights and organic LEDs). It has been shown that differences in inter-industry measurements are still large, yet it is necessary to measure LEDs in a precise, accurate, well defined and, we would say, traceable manner.

Fig. 1. NPL's reference goniophotometer.

In many cases, manufacturers rely on customer feedback to reveal the failings of LED products. Better measurement will produce better LEDs more efficiently, and lumens per dollar is a standard that industry understands.

Quality measurement is also driven by safety, covering areas such as conspicuity of signalling lamps and photobiological hazards of high-brightness LEDs. This area also includes the need to conform to international regulations and standards, an effort to which the UK's National Physical Laboratory (NPL) is currently contributing.

Optical radiation measurement

The measurement of the optical radiation characteristics of LEDs can be divided into four interrelated categories: photometry, radiometry, and spectral and angular distribution. Measurements are needed for product development and quality control, to enable comparisons to be made between products, and for specification and safety purposes. Traceability to national standards (such as those developed and maintained at NPL) is also important, because this helps to ensure consistency and gives the market confidence in the claims that manufacturers' make for their products.

Photometry

Photometry is the measurement of light weighted by the response of the human eye (i.e. it measures the ability to generate a visual response). As many LED products are made to been seen by people, it is perhaps the most important measurement. However, it is also often the area with the greatest measurement error. These errors have three main causes: spectral mismatch errors in the photometric detectors; problems with geometric alignment; and temperature dependence of the luminous and spectral output of the LED.

To measure a photometric quantity, the detector used – a photometer – must have a spectral responsivity that is matched to the visual response of the human eye. Photometers generally incorporate optical filters such that the transmission of the filter and the spectral response of the detector work in combination to match the response of the eye closely. However, no photometer can be perfectly matched to this function, with the result that errors occur when one is used to measure a light source that is different from the source against which it has been calibrated. These errors can be very large – errors of tens of percent are common. Appropriate calibration of the photometer can minimize the errors but, for work of the highest accuracy, a spectroradiometer is generally recommended, which measures the light energy at individual wavelengths so that the photometric quantities can be calculated using the defined weighting functions.

The novel construction and packaging of LEDs also create special difficulties in measuring their light output, because they lead to highly directional and non-uniform light-distribution patterns. Furthermore, the mechanical and optical axes may not be coincident, which can lead to inconsistencies between different measurement systems – a problem that is compounded in LED clusters. Correct geometrical alignment is therefore important if consistent and reproducible measurements are to be made. The CIE, for example, recommends that, for single LEDs, the mechanical axis rather than the optical axis should be taken as the reference for measurements of luminous intensity or illuminance. Geometric alignment is less critical for measurements of the total luminous flux (i.e. the total light output in all directions,

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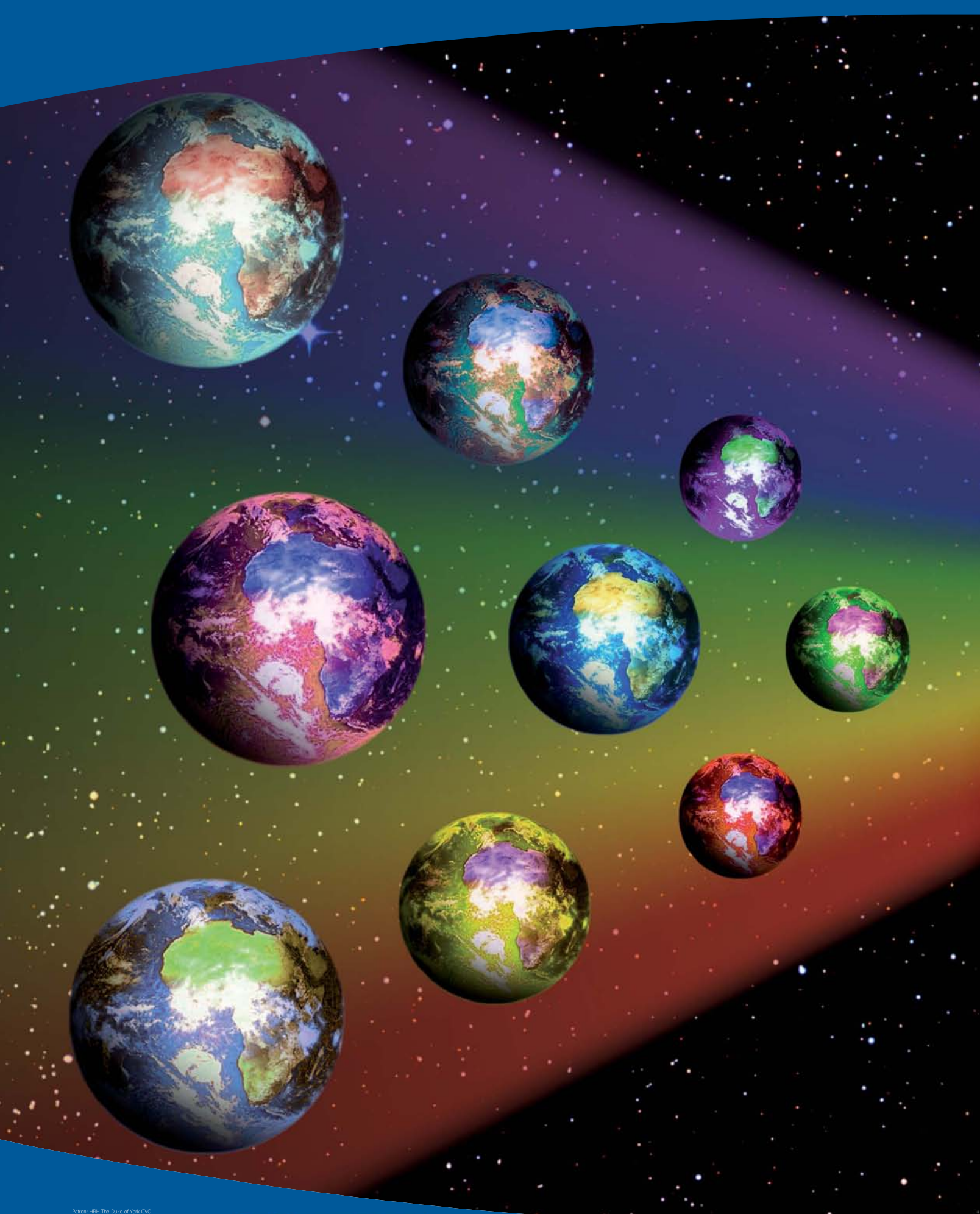

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usually measured using an integrating sphere), but this is a less useful parameter for comparing the "brightness" of one LED with that of another.

As semiconductor devices, LEDs are temperature sensitive. As a consequence a change in temperature, produced by current heating or ambient temperature, can change the spectral distribution and intensity of the LED emission. It is therefore recommended that LEDs are temperature stabilized and operated at constant current.

Radiometry

Radiometry refers to measurement of all optical radiation, whether infrared, visible or ultraviolet, either in terms of the total power summed over all wavelengths at which the LED emits, or as a function of wavelength. The basic unit reported for IR and UV LEDs is usually radiant power in watts, which is the spectrally integrated value. The primary measurement method is to use an integrating sphere, where all of the light emitted from the LED in all directions is measured. The same precautions used for measuring LEDs photometrically should also be followed when making radiometric measurements.

Spatial characteristics

Manufacturers produce LEDs with different spatial characteristics,but seldom state the degree of asymmetry of the light distribution pattern or the change in output as a function of angle. It is often assumed that the radiation pattern of circular LEDs is both Gaussian and symmetric, yet this is often not the case. Knowledge of the angular dependence is necessary for a range of applications, including displays and traffic signals. A traffic-light, for example, requires a narrow angular distribution (so that the signal does not confuse drivers approaching a junction from other directions), whereas a display requires a wide distribution so that it can be seen from almost any angle.

The spatial distribution of an LED can be characterized using a goniometer, and measurements are made either by moving the detector around the sample or by tilting the LED. NPL has many integrating spheres and goniophotometers, and the one chosen for a particular measurement depends on the size and power of the light. The reference goniophotometer (figure 1) has a maximum detector to source distance of 15 m, which can permit very high angular resolution of large sources, such as luminaires and spotlights.

Standards

Difficulties in the measurement of LEDs have been highlighted by discrepancies in the measurement results between different laboratories. Different instruments measure different optical radiation characteristics with varying degrees of success. Many offer precision, but not all deliver the measurement accuracy required.

At present there are few standards, and performance varies from one measurement facility to another. However, help is at hand. The Commission Internationale de L'Eclarage (CIE), the international commission on illumination, has been establishing guidelines for measuring LEDs since 1997. Teresa Goodman at NPL is currently the division director of CIE Division 2, which covers the physical measurement of light and radiation. The latest progress of the various technical committees (TCs) is described below (for more details of the committees, see the CIE Division 2 website at http://cie2.nist.gov):

TC2-45 is concerned with the measurement of single LEDs. The aim is to revise CIE 127 (see "Standardization of LED measurements"

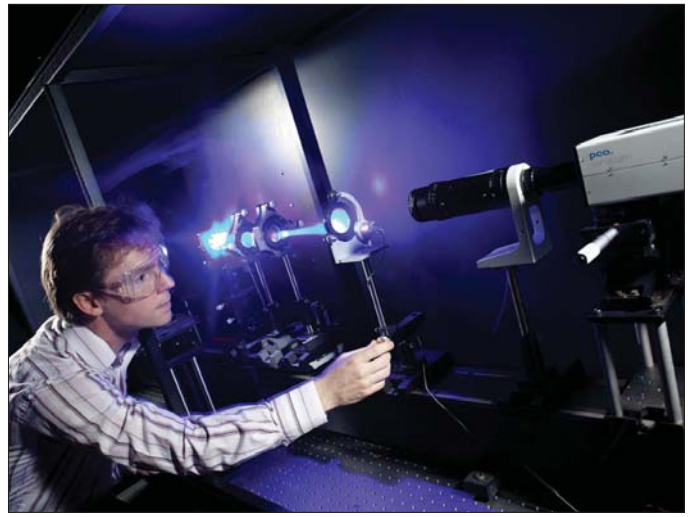

Fig. 2. NPL's facility for measuring LED apparent source size.

"Confirming the photobiological safety of products that may be shone directly into people's eyes is obviously extremely important."

LEDs Magazine – see Links box) to include improved definitions of quantities and methods of measurement for total flux and partial flux of LEDs and to reevaluate other parts, including spectral and color measurements of LEDs. The measurement issues discussed above are detailed, with particular reference to the measurement of luminous flux, which is important in lighting and signaling applications.

The preparation of an international CIE/ISO (International Standards Organisation) standard on the measurement the luminous intensity of LEDs is being carried out by TC2-46. This will support development and trade, but compliance with its recommendations will present a challenge to manufacturers.

The special problems associated with measurements of LED clusters and arrays are being addressed by TC2-50. The efforts of this TC are being supported by the work of a focused interest group formed within the Optical Radiation Measurement Club (a measurement forum run by NPL), which has been studying the measurement issues surrounding LED clusters and will report its findings shortly in a best-practice guide report (see http://www.npl.co.uk/optical_radiation/ormclub/fig/#led%20clusters%20wg).

Safety

Recent significant advances in the brightness of LEDs and the introduction of devices emitting at shorter wavelengths has led to increasing concern regarding the photobiological safety of LED products. High-brightness LEDs are being incorporated into lighting products such as traffic-lights, torches and car headlamps, which may be shone directly into people's eyes. Confirming the photobiological safety of such products is obviously extremely important.

From a photobiological safety standpoint, the spectral characteristics, radiance ("brightness") and apparent source size of the LED

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Links

NPL's Optical Radiation Team www.npl.co.uk/optical_radiation
NPL's Optical Radiation Measurement Club
www.npl.co.uk/optical_radiation/ormclub
CIE Division 2 (Physical Measurement of Light and Radiation)
http://cie2.nist.gov
Investigation of a measurement technique to determine the apparent source size for light emitting diodes (PDF, 1 MB)
www.hse.gov.uk/research/rrpdf/rr345.pdf

On our website:
Standardization of LED measurements
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are all important. Apparent source size dictates the size of the light patch on the retina after it has travelled through the light focussing parts of the eye. In safety standards, LEDs have been treated both as lasers (IEC 60825 series) and as lamps (CIE S 009/E:2002 "Photobiological safety of lamps and lamp systems"). This has caused some confusion relating to the risk on the part of both customers and, more important, manufacturers. Measurement errors add to the confusion because LED sources often incorporate some form of lens, and this means that the "apparent source size" ("optical size") is not the same as the physical size of the LED chip ("die").

Both of the standards for LEDs (see above) require a consideration of the apparent source size. NPL has carried out research for the UK Health and Safety Executive to develop a method of measuring apparent source size (see Links box) and the facility for its measurement is shown in figure 2.

If, as expected, LEDs are removed from IEC 60825-1 and moved to CIE S 009 (which has been submitted to the IEC to allow it to become a joint IEC/CIE standard), it will make the issue of LED safety clearer. This will also have an impact on compliance for European conformity CE marking, though it must be noted that this has often not been rigorously followed by manufacturers.

Also on the horizon is the EC physical agents (optical radiation) directive "on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (optical radiation)". This "sunshine directive" deals with risks arising from exposure to optical radiation and may have an impact on some LED applications. It is set to be incorporated into European law by 2010 and will perhaps benefit from the clarification of LED safety requirements discussed above, but those responsible for its enforcement will need to keep pace with ongoing developments of LEDs.

About the authors

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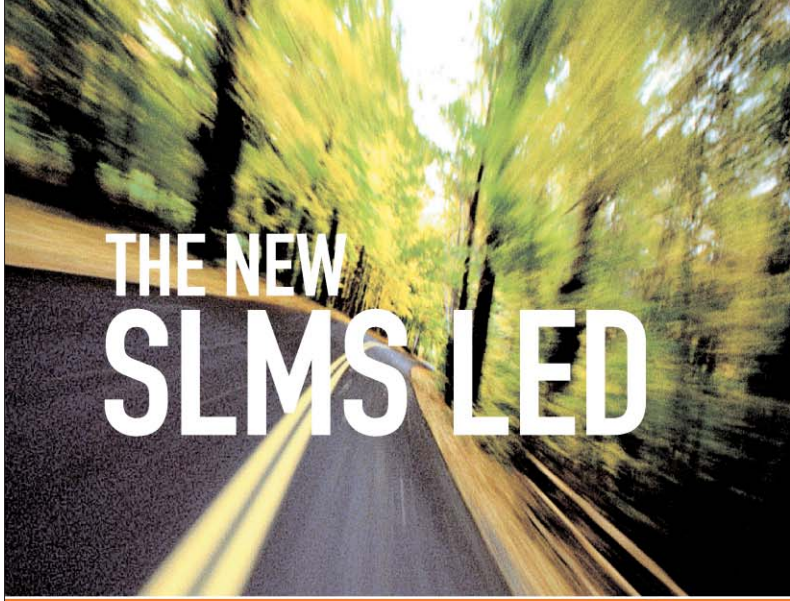

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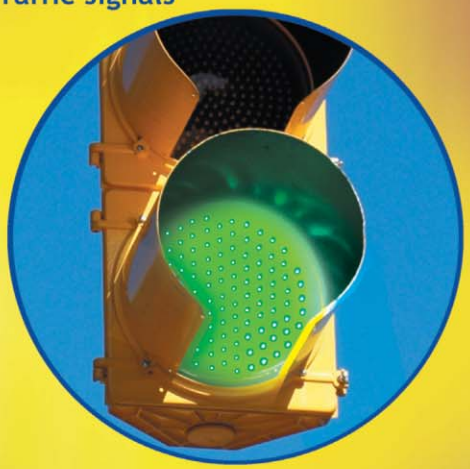

Exterior displays

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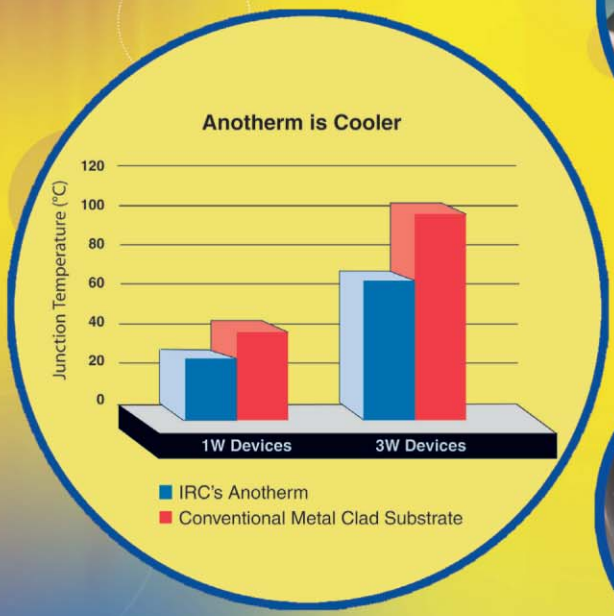

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LED Suppliers Guide

● LED packages ● Light engines & modules

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Tel: +43 662 44991 343
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Fax: +1 949 951 3974
E-mail: mfinn@bivar.com
Web: www.bivar.com

Founded in 1965, Bivar is an established industry leader in optoelectronics innovation and solution engineering. We offer the industry's largest choice of LEDs and LED assemblies. New products include Hi-Brite LED modules, flexible and rigid light pipes, and wedge-based LEDs. Our Design Center Solutions Business Unit formalizes many existing capabilities into a platform focused on application-specific optoelectronics and packaging solutions that cost-effectively speed customer time-to-market.

● Optics

BFi OPTiLAS Ltd

Mill Square, Wolverton Mill South, Milton Keynes MK12 5ZY, UK
Contact: Lis Eastham, sales engineer
Tel: +44 1908 326 326
Fax: +44 1908 221 110
E-mail: lis.eastham@bfioptilas.com
Web: www.bfioptilas.com

BFi OPTiLAS Ltd, part of a pan-European distribution organization, offers a range of specialist lighting products suited to many illumination applications. Of particular interest, Luminit (formerly Physical Optics Corporation) offers holographically mastered light-shaping diffusers. LSD offers controlled symmetric and asymmetric beam-distribution capabilities and high transmission (up to 92%).

The LSD technology allows the user to manipulate the shape of light output from LEDs, lamps and filaments. As a secondary optic they are suitable for applications such as projection displays, 3D displays, LCD displays, LED backlighting, instrumentation, architectural lighting, traffic and information signs, and many others.

As distributors, we also offer a very wide range of products and components for the electronics and electrical industries, many of which will be of interest to the OEM manufacturer.

● Illumination

CEZOS sj

81-534 Gdynia, ul.Olgierda 88B, Poland
Contact: Cezary Skotak
Tel: +48 58 664 88 61
Fax: +48 58 664 66 65
E-mail: cezos@cezos.com
Web: www.cezos.com

One approach to energy savings is to replace standard MR16 (20 W, 35 W, 50 W) bulbs with MR16 LEDEMITY made by Cezos. We base our products on Luxeon 3 × 1 W LEDs, original optics constructed by LEDIL and our electronics. Please check our quality and solutions.

● High-power LEDs ● LED packages ● Mobile appliances ● Vehicle lighting ● Displays, signs & signals

Citizen Electronics Co Ltd

1-23-1, Kamikurechi, Fujiyoshida, Yamanashi-ken 403-0001, Japan
E-mail: inquiry@mail.c-e.co.jp
Web: www.c-e.co.jp/e/

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● Optics

Carclo Technical Plastics

111 Buckingham Avenue, Slough, Berkshire SL1 4PF, UK
Contact: Ian Bryant, business development manager
Tel: 0044 1753 575 011
Fax: 0044 1753 811 359
E-mail: sales@carclo-optics.com
Web: www.carclo-optics.com

Carclo Technical Plastics (CTP) designs, moulds and markets optical, plastic components for a variety of industries encompassing LED optics, automotive, medical, telecommunications and low-vision magnifiers. CTP has always been at the leading edge of optical technology since its foundation in 1936. Such development has seen them placed at the forefront of its class. It has its own optical design department with full CAD facility and applications software. In addition it has specialist tooling and optical polishing capabilities with considerable experience in processes such as protective coatings, pad printing and in-mould foil, which are all carried out on site.

Recent advances in high-power LED technology have led CTP to develop a range of high-efficiency collimator lenses complemented by a range of holders for all the popular LED package types.

Carclo-Optics is BS EN ISO 9001 accredited.

Citizen Electronics is one of the world's leading manufactures of chip-LEDs for cellular phones, cameras, backlights for LCD panels, and light sources for car instrument panels. Citizen Electronics offers a wide variety of electronic devices, including the world's first one-package subminiature illuminated tactile switches, high-sensitivity sensors and acoustic products.

● Light engines & modules ● Drivers & control ● Illumination ● Architectural, entertainment & decorative lighting ● Displays, signs & signals

Color Kinetics

10 Milk Street, Suite 1100, Boston, MA 02108, USA
Tel: +1 617 423 9999
Fax:+1 617 423 9998
E-mail: info@colorkinetics.com
Web: www.colorkinetics.com

Color Kinetics transforms environments through new, dynamic uses of light. Its solid-state lighting systems apply the benefits of LEDs as a highly efficient, long-lasting, environmentally friendly and inherently digital source of illumination. The company is headquartered in Boston, MA, USA, with offices in the UK, China and Japan.

● High power LEDs ● LED packages ● Light engines & modules ● Optics ● Drivers & control ● Multiple applications

CML Innovative Technologies

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Fax: +44 (0)1933 676 838
E-mail: pward@cml-it.com
Web: www.cml-it.com

CML Innovative Technologies (CML-IT) is one of the largest worldwide suppliers of miniature lighting components and systems, with 1800 employees and annual revenues of $200 million. A vertically integrated designer, manufacturer and seller of the widest selection of miniature lighting solutions, CML-IT serves a wide range of industries, such as automotive, rail, marine, aviation, gaming and leisure, illumination and signalling, consumer/domestic appliances, electronics/IT applications and architectural lighting.

A multidisciplinary approach is taken to ensure that each product meets or exceeds critical requirements for light output, functional design, energy consumption and service life in every different market. By combining global resources with a local and specialized response, CML-IT addresses customer needs precisely, completely and cost-effectively. Continual enhancement of its design and manufacturing technologies enables CML-IT to offer its worldwide customer base an ever-wider range of products and services.

From R&D, initial design and raw material purchase to high-speed customized manufacturing and worldwide distribution, CML-IT maintains total control over the entire process.

● Packaging

Cool Polymers

333 Strawberry Field Road, Warwick, RI 02886, USA
Contact: Gary Arnold, sales manager
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Fax: +1 401 732 6119
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Web: www.coolpolymers.com

Cool Polymers is the world's only dedicated manufacturer of thermally conductive plastics. CoolPoly thermally conductive materials are used in LED die encapsulation, LED substrates and LED packaging. CoolPoly grades are 3D net-shaped injection moldable, provide thermal management for high-power LED applications, and are lightweight, energy saving and RoHS compliant.

● High-power LEDs ● LED packages ● LED chips

Cree LED Light

4600 Silicon Drive, Durham, North Carolina 27703, USA
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Tel: +1 919 287 7768
E-mail: mark_mcclear@cree.com
Web: www.cree.com

A market-leading innovator and a pioneer in the development of solid-state lighting semiconductors and devices, Cree LED Light is leading the LED lighting revolution, advancing the performance of solid-state lighting. Cree products include white and a full range of color LEDs for brighter and more tunable light in general illumination and LED backlighting solutions for more vivid displays.

Cree's XLamp LEDs are leading the way for lighting designers to create more flexible, long-lasting and energy-efficient lighting systems. The devices are available in a full range of color (white, royal blue, blue, cyan, green, amber, red-orange and red).

Cree, the Cree logo and XLamp are registered trademarks of Cree, Inc.

● Illumination ● Architectural lighting

Crescent Lighting

8, Rivermead,Pipers Lane, Thatcham, Berkshire RG19 4EP, UK
Contact: Alan Weaver, sales director
Tel: +44 (0)1635 87 88 88
Fax: +44 (0)1635 87 38 88
E-mail: sales@crescent.co.uk
Fax: www.crescent.co.uk

Crescent Lighting designs, manufactures and distributes innovative, contemporary commercial LED systems throughout Europe. With 10 years' experience of LED lighting, we have a wide range of standard products using the latest LED sources. Part of the Fiberstars group of companies, we also distribute Ambiance Lumiere LED systems in the UK.

● Illumination ● Architectural lighting ● Displays, signs & signals

Cyberlux Corporation

4625 Creekstone Drive, Suite 100, Research Triangle Park, Durham, NC 27703, USA
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Fax:+1 919 474 9712
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Hitaltech
A group of connecting technologies

COMPONENTS FLEXIBLE FRIEND

Whilst saving space, these cables eliminate the need for hardwiring between rigid PCBs, thus reducing cost, whilst also offering high flexibility allowing the cable to be formed into various shapes offering a space saving element.

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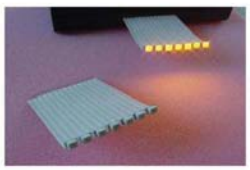

Using round flat round technology, the cable can be terminated directly onto a rigid PCB. The cable can be over moulded to increase protection making it suitable for outdoor environments or Laminated Insulation Foil for more complex circuits.

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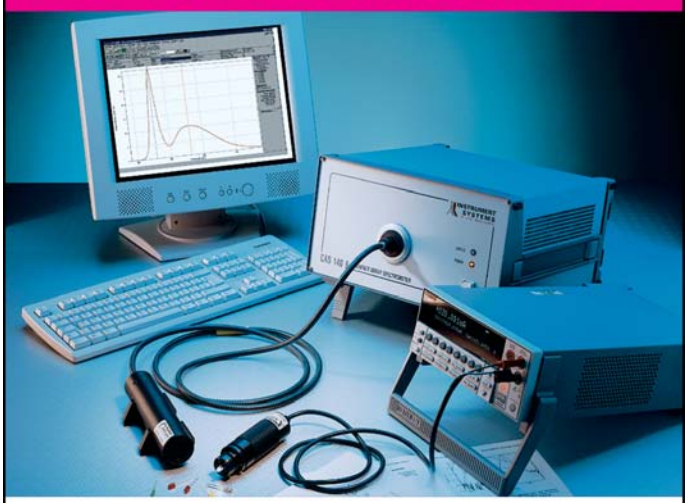

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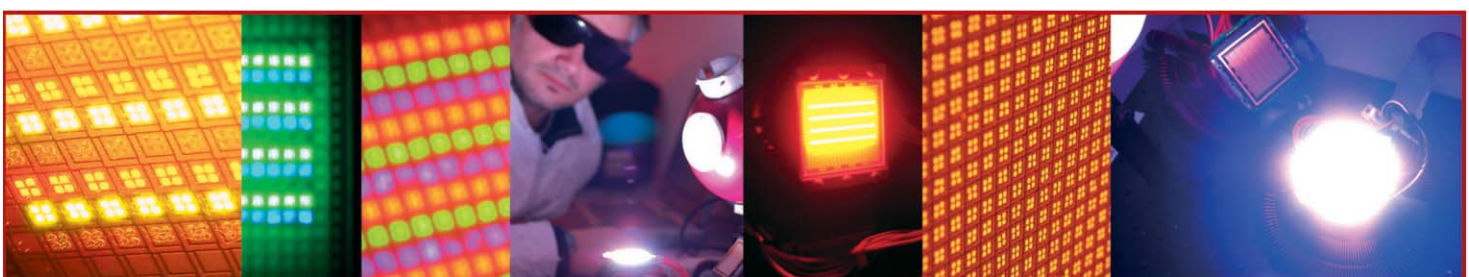
INSTRUMENT SYSTEMS
OPTISCHE MESSTECHNIK

phone +49 89 45 49 43-0
info@instrumentsystems.de
www.instrumentsystems.de

WE BRING QUALITY TO LIGHT



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● High-power LEDs ● Light engines & modules ● Optics ● Drivers & control ● Multiple applications

Dialight Lumidrives Ltd

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Fax: +44 (0)1423 798 266
E-mail: sales@lumidrives.com
Web: www.lumidrives.com

Dialight-Lumidrives was one of the first companies to realize the potential of high-powered LED technology in illumination applications. Its continuing success is based on a proven track record of identifying applications to which it can bring true innovation and value. Dialight-Lumidrives manufactures and markets a broad range of products, including state-of-the-art power drivers, RGB and single colour LED arrays, and an extensive collection of optics. The company also offers a design service for LED based illumination systems.

Dialight-Lumidrives has supplied the core technology behind many well publicized projects and products, and its clients are located in a variety of industry sectors, from innovative start-ups to global lighting manufacturers. The applications covered are wide ranging and encompass architectural, accent, emergency and entertainment lighting, together with beacon lighting for the emergency services.

Cyberlux Corporation (OTC Bulletin Board: CYBL) has created breakthrough LED lighting technology that provides the most energy-efficient and cost-effective lighting solutions available today, including task and accent lighting in homes and businesses, emergency lighting, and covert military and homeland security lighting.

● Displays, signs & signals

Daktronics

Brookings, SD, USA
Tel: +1 605-697-4300
E-mail sales@daktronics.com
Web: www.daktronics.com

Daktronics is one of the world's largest suppliers of electronic scoreboards, computer-programmable displays, and large screen video displays and control systems. The company began manufacturing large screen, full-color LED displays in 1997. Since then, over 2000 ProStar and ProAd full-color displays have been sold and installed in sports, entertainment and commercial applications worldwide.

● Illumination ● Displays, signs & signals ● Industrial lighting ● Medical, industrial & other

ECIE CITYLights srl

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Fax: +39 02 933 7252
E-mail: info@eciecitylights.it
Web: www.eciecitylights.it

ECIE CITYLights is a Nur Group company specializing in LED lighting products and services.

ECIE CITYLights Products Division develops, produces and sells LED-based lighting applications, particularly for the general illumination segment. Development is carried out utilizing the research and development capabilities of its sister company ECIE Engineering (www.ecieengineering.it), while production is carried out in–house in Italy and China as well as through third parties in Italy.

LED-based products sold include indoor and outdoor spots, downlighting, accent lighting and relative drivers for LED power management and control, as well as flashlights, lanterns and solar-powered garden lights.

ECIE CITYLights Services Division specializes in the design and production of turnkey LED-based systems according to client specifications.

ECIE CITYLights also offers services aimed at OEM lighting manufacturers seeking to convert to LED technology, offering them design and manufacturing capabilities for "drop in" LED systems to replace existing lighting products.

● High-power LEDs ● LED packages ● Packaging ● Optics ● Drivers & control ● Multiple applications

Data Display Products

445 South Douglas Street, El Segundo, CA 90245, USA
Tel: +1 310 640 0442, +1 800 421 6815
Fax: +1 310 640 7639
E-mail: techsupport@datadisplay.com
Web: www.datadisplay.com

Since 1970, Data Display Products has pioneered the design and development of LED packaging technology for indication and illumination. Through the years, dynamic advances in LED technology have resulted in greater intensities and a broad selection of colors. Our experienced applications engineers provide technical support, suggest and provide LED samples for evaluation, and design innovative custom LED solutions for specific applications.

● Packaging ● Optics ● Drivers & control ● Multiple applications

EcoLED Lighting

WSR Building, Longwood Business Park, Fordbridge Road, Sunbury on Thames, Middlesex TW16 6AZ, UK
Contact: Robin Day, managing director
Tel: +44 (0)7980 840 425
E-mail: info@ecoledlighting.com
Web: www.ecoledlighting.com

EcoLEDLighting specializes in "off-grid" solar, wind and mains-powered LED lighting products. EcoLEDLighting has brought together a total of 22 years of cutting-edge LED lighting technology experience gained in the aerospace industry. Our designs and products reflect this experience in the production of 100% recyclable, durable, state-of-the-art lighting solutions. Our basic product range provides lighting solutions for environmentally aware architectural, retail, security, safety, emergency relief response organisations, disaster relief and ecotourism sites where substantial energy savings, ambient heat reduction, and ultimate refinement and durability are the key requirements of our clien tbase.

● Illumination ● Architectural lighting

DGA

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Tel: +39 055 898 6235
Fax:+39 055 898 6243
E-mail: export@dga.it
Web: www.dga.it

We are the leader in lighting with POWERLED technology. DGA offers a wide collection of high-quality luminaries for architectural lighting. Light quality is guaranteed by a tough selection of LED components that ensures consistent colour temperatures and efficiency lighting with a remarkable colour-rendering index. Italian design completes the product features.

● Packaging

Dow Corning Corporation

2200 Salzburg Road, Auburn, MI 48611, USA
Tel: +1 989 496 6000
E-mail: electronics@dowcorning.com
Fax: www.dowcorning.com/electronics

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● High-power LEDs ● Light engines & modules ● Drivers & control ● Illumination ● Architectural lighting

Elumina Technology Inc

12F, No. 237 Song Jiang Road, Taipei, Taiwan
Contact: Stan Shaw, general manager
Tel: +886 2 2517 4870
Fax: +886 2 2517 3380
E-mail: info@eluminatech.com
Web: www.eluminatech.com

Elumina's LED lighting systems provide high brightness, low energy, reliable lifetime, and low maintenance. Products include LED accent lites, high-power modules, RGB lighting controllers, solar ground lights, LED traffic lights, LED modules and more LED solutions for outdoor applications.

Elumina is devoting her ISO 9001 quality-assured manufacturing from LED packaging to LED optical and heat path patented designs. Founded in 2001, Elumina has been continuously valued by our customers as a highly competent partner in the fields of design, engineering and deployment using LED lighting systems.

Elumina is continually focused on further expansion in the advanced application solutions of transportation signals, accent lights, light bars and OEM/ODM. Elumina would be an advantage for either customized or application products.

Dow Corning is a global leader in silicone-based technology and innovation, and its recent focus on light management meets customers' needs for materials for LEDs. Recent efforts have been focused on new silicone materials for both lens and encapsulant applications in LED packaging. Silicone-based materials have very high transmission in the UV–visible wavelengths, do not degrade when exposed to light or temperature, and can be offered in a wide range of moduli and refractive indices.

● High-power LEDs ● LED chips ● Light engines & modules ● Optics ● Drivers & control ● Multiple applications

EBV Elektronik GmbH & Co KG

Im Technologiepark 2-8, 85586 Poing, Germany
Tel: +49 (0)8121 774 0
Fax:+49 (0)8121 774 422
E-mail: generallighting@ebv.com
Web: www.ebv.com

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Multiple applications

ENFIS Ltd

Technium 2, King's Road, Swansea Waterfront, Swansea SA1 8PJ, UK
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Fax: +44 (0)1792 485 537
E-mail: info@enfis.com
Web: www.enfis.com

Enfis has developed world-leading brightness multiwatt MW, multiple wavelength smart LED array light engines. Various wavelengths can be packaged into the array, with each wavelength individually controlled.

Colour-changeable "white light" can be produced through the combination of RGB(Y). UV, visible spectrum and IR wavelengths can be combined on the same array to produce highly adaptable products across many industry segments.

Each Enfis patent-pending smart MW-LED array has active light- and heat-sensing components that control, calibrate and regulate the light output of each wavelength on the array. By combining Enfis smart array technology with efficient thermal management, optics and electronics, Enfis produces world-leading optical power output light engines. Typical power densities are:

- UVB/C (<320 nm) >20 mW/cm^2
- UVA (370–420 nm) >300 mW/cm^2
- BLUE (440–480 nm) >2500 mW/cm^2
- GREEN (500–535nm) >1000 mW/cm^2
- YELLOW (590–610 nm) >1000 mW/cm^2
- RED (630–690 nm) >2500 mW/cm^2
- NIR (750–980nm) >2500 mW/cm^2

EBV Elektronik, an Avnet company, is one of the leading specialists in European semiconductor distribution. 240 technical sales specialists provide a strong focus on a selected group of long-term manufacturing partners. 110 continuously trained application specialists offer extensive application know-how and design expertise. More information about EBV Elektronik is available at www.ebv.com.

● Vehicle lighting

ECIE srl

Via Settembrini, 102 Lainate (MI) 20020, Italy
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Tel: +39 02 933 0071
Fax: +39 02 933 0072 52
E-mail: ecie@ecie.it
Web: www.ecie.it

● Light engines & modules ● Drivers & control ● Illumination

EREA NV

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Fax: +32 (0)3 355 16 01
E-mail: sales@erea.be
Web: www.erea.be

EREA, a Belgian producer, offers – in addition to a wide range of transformers for halogen lighting – modules, power supplies and finished products based on LEDs. In association with important international lighting producers, we have LED realizations in public lighting, interior lighting, lighting for monuments and historical buildings, publicity lighting and more.

In the design and realization of your projects, EREA can prove to be the vital link. We have the know-how and are well up in lighting. Through co-operation and a well considered design, your wishes and projects are translated into a product, in which the whole matches perfectly with an ultimate light output and lifespan. EREA is specialized in many fields.

A team of dynamic designers and product specialists is ready to advise and assist you at any time, from the start to the final realization of your projects.

ECIE is a Nur Group company specializing in the development, production and sales of LED-based automotive lighting and instrumentation products for motorcycles, mopeds, scooters, mini-cars, buses and agricultural vehicles for third parties and OEM producers. Product development is done in conjunction with its sister company, ECIE ENGINEERING (www.ecieengineering.it).

● Optics ● Test & measurement ● Illumination

ECIE ENGINEERING srl

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Fax: +39 02 933 0072 52
E-mail: info@ecieengineering.it
Web: www.ecieengineering.it

ECIE ENGINEERING is a Nur Group company highly specialized in product development, offering optical, electronic and mechanical design and test and quality certification services for LED-based products. Since 1991 it has developed more than 200 new products with 50 patents in automotive and general lighting.

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High-power LEDs · LED packages · LED chips · Light engines & modules · Packaging · Optics · Displays, signs & signals

ETG Corporation

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Tel: +1 310 202 6400
Fax: +1 310 202 6406
E-mail: info@etgtech.com
Web: www.etgtech.com

ETG Corporation is your "one-stop-shop" for leading LED technologies. Some of our products include standard LED assemblies, surface-mount LEDs, SMT LED assemblies, LED custom clusters, LED bulbs and Cree XLamp products including 1 W and 3 W LEDs, ultraviolet and custom solutions.

ETG Corp is an expert Cree XLamp integrator and has all the experience you need to get your high-power solid-state lighting project off the ground. Allow ETG to be your design and manufacturing solution for all your lighting needs.

ETG Corp
Solid State Lighting Innovations

Industry groups

EPIC (European Photonic Industry Consortium)

17 rue Hamelin, 75016 Paris, France
Thomas Pearsall, general secretary
Tel: +33 145 05 72 63
Fax:+33 145 05 72 63
E-mail: pearsall@epic-assoc.com
Web: www.epic-assoc.com

EPIC, the Europe-wide photonics professional association, is an independent organization owned and operated by its members. Membership is open to all organizations with an interest in photonics and a business presence in Europe. EPIC's main activities are advising and counselling he EC; ownership and development of the photonics roadmap for European industry; and reorientation of university research programs towards emerging markets.

Displays, signs & signals

Euro Display

Strada della Risera 7, 10090, Rosta, Turin, Italy
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Tel: +39 119 54 10 15
Fax:+39 119 54 10 17
E-mail: fabio.aversa@eurodisplay.com
www.EuroDisplay.com

LED packages · Light engines & modules · Packaging · Optics

Evident Technologies

216 River Street, Troy, New York, 12180, USA
Contact: Michael Locascio, CTO
Tel: +1 518 273 6266
Fax: +1 518 273 6267
E-mail: info@evidenttech.com
Web: www.evidenttech.com

Evident is a pioneer in the development of advanced quantum dot nanomaterials engineered to create unique colors on blue, UV and other LEDs. Evident's proprietary quantum dot emitters are tunable from blue (490 nm) to the near infrared (2300 nm). They offer a unique way to control color emission on solid-state devices, simplified designs using a single LED driver, more tunable forms of white, flexible form factors, and a broader range of optical options, such as non-scattering.

Evident has an expanding intellectual property portfolio covering the use of its materials in lighting and display devices. Evident also works jointly with customers and partners to bring quantum dot-based products to market on their own platforms.

Evident's track record for providing high-quality nanomaterials, a range of valuable services and fast-track solutions has made it a leader in the development of applications and products using quantum dot technologies.

evident TECHNOLOGIES

The Euro Display team has over 25 years' expertise in the LED displays industry. Our LED giant screens are used in the media, entertainment and information markets. All members of our team share the same passion for LED technology, at the service of such a fascinating business as communication.

High-power LEDs · LED packages · LED chips · Light engines & modules · Multiple applications

E Wave Corporation

159 Bittacy Hill, London NW7 1RT, UK
Contact: Nigel Standen, general manager
Tel: +44 (0)20 8346 5219
Fax: +44 (0)20 8346 6873
E-mail: sales@ewave-corp.com
Web: www.ewave-corp.com

E Wave provides high-intensity LED wafers, chips and packaged devices in the UV, visible and infrared wavelength ranges. Custom production and sorting are available for special wavelengths and intensity grades. One of our subsidiaries specializes in white LED lights.

Optics

Fraen Srl

80 Newcrossing Road, Reading, MA 01867, USA
Contact: Scott Grzenda, Americas sales
Tel: +1 781 205 5349
Fax: +1 781 942 2426
E-mail: optics@fraen.com
Web: www.fraensrl.com
Contact: Guido Campadelli, Europe/Asia sales
Tel: +39 0290 394 049
Fax: +39 0290 399 796
E-mail: info@fraen.it

Maximizing light – Fraen Srl develops products that manage light in ways never before achieved in the lighting industry. As a result of rich knowledge and innovation of optical systems, Fraen Srl is the world's leader in custom optical solution and standard optics for high-powered LEDs.

FRAEN
THE POINT OF PRECISION

Test & measurement

G&R Labs

2934 Scott Boulevard, Santa Clara, CA, 95054, USA
Contact: George Richardson
Tel: +1 408 986 0377
Fax:+1 408 986 0416
E-mail: george@grlabs.com
Web: www.grlabs.com

We manufacture instruments that measure output in mW/cm^2. Our calibrations are NIST traceable. Our probes are cosine-corrected for physically close readings to allow matching probes for the same readings. Our meters have a five year warranty.

High-power LEDs · LED packages · Optics · Drivers & control · Multiple applications

Guang Li-Light Power Technology

136 Guang Fu Street, 5F-1, 970 Hualien, Taiwan, ROC
Contact: Michael Burton, sales manager
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Fax: +886 3832 7917
E-mail: mbguangli@yahoo.com
Web: www.guangli-lightpower.com

We are your one-stop supplier offering a wide range of LEDs from high-power to topled and related components. Typical applications for LEDs we deliver are highway messageboards and full-color video displays. Our services include procurement of LEDs pursuant to customer specifications, customer support and after-sales follow-up.

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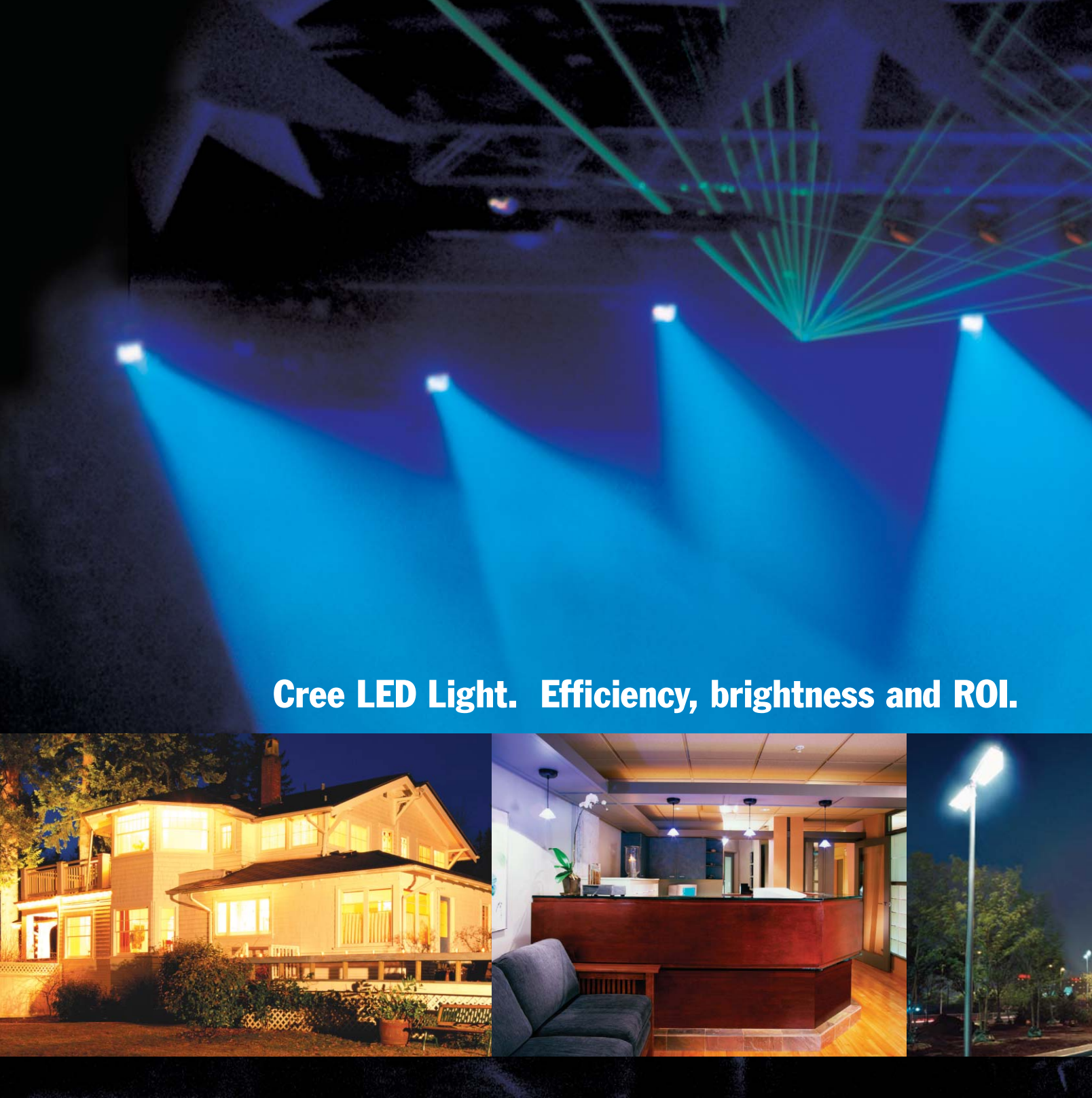

Cree LED Light. Efficiency, brightness and ROI.

www.cree.com

+1.919.313.5300

The Revolution Starts Now.

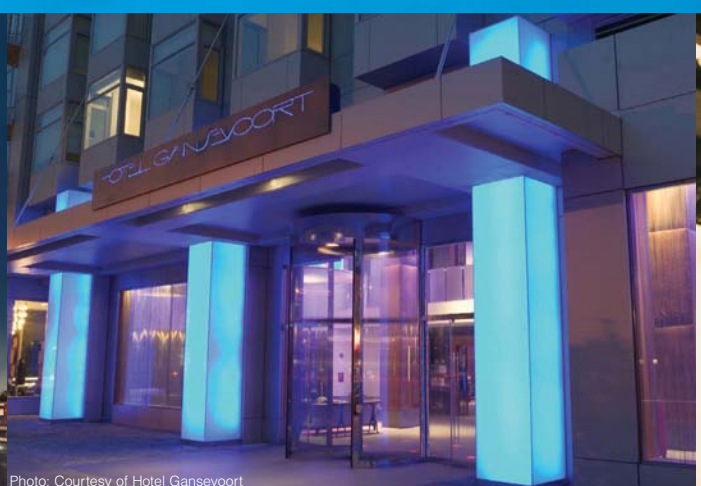

Photo: Courtesy of Hotel Gansevoort

Cree is leading the revolution in LED lighting. We invite you to see how Cree LED light can improve your next design.

CREE®
LED Light

● Packaging

GrafTech International – Advanced Energy Technology

11709 Madison Avenue, Lakewood, Ohio 44107, USA
Contact: John Schober, Marketing
Tel: +1 216 529 3761
Fax: +1 216 529 3888
E-mail: john.schober@graftech.com
Web: www.egraf.com

Advanced Energy Technology Inc. (AET), a subsidiary of Graftech International Ltd., specializes in developing custom thermal management solutions that leverage the unique thermal properties of natural graphite. AET has helped to resolve some of the toughest thermal management challenges in the consumer electronics market via our eGRAF® product line, which includes thermal interface material, heat spreaders, and heatsinks, and the LED market is deriving similar benefits from our products and capabilities.

We are excited to introduce eGRAF® zSPREADER™ heat spreaders, the newest product in our portfolio. Used with standard printed circuit boards, zSPREADER™ heat spreaders provide lower thermal resistance compared with Al- or Cu- based metal core printed circuit boards, offering the best cooling value for high-power LEDs.

Contact us at www.egraf.com to learn more about how AET can improve light output, reduce power consumption, or reduce lifetime cost in your LED application through improved thermal management.

GRAFTech ADVANCED ENERGY TECHNOLOGY INC. eGRAF® *A GrafTech International Ltd. company*

● High-power LEDs ● LED packages ● Light engines & modules ● Mobile appliances ● Displays, signs & signals

Harvatek

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Harvatek is one of the world's largest manufacturers of surface-mount LEDs. Its solid-state lighting solutions are utilized in numerous applications, including mobile phones, hand-held media systems, LCD displays and appliances. Harvatek's portfolio of products includes SMD LEDs, high-power and high-brightness LEDs, through-hole LEDs, seven-segment displays and more.

● Light engines & modules ● Drivers & control ● Illumination ● Architectural lighting ● Displays, signs & signals

GVA Lighting Inc

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Web: www.gvalighting.com

GVA Lighting is a Canadian designer and manufacturer of professional LED lighting products. Our architectural product offering includes linear lighting fixture STR8 and STR7 series for kitchen under cabinet, cove, retail and library undershelf applications; adjustable spotlights Ducat™ and Gulden™ or accent and task lighting; line of miniature LED luminaires, CoinLight, excellent for display and other case work installations; and newly available is our STR9 linear outdoor wall washing luminaire.

We are experts at microelectronic and thermal management design for mid- and high-power LEDs. Our professionally designed proprietary LED drivers work in conjunction with our optional controls. We offer smooth, eye sensitivity optimized, flicker-free dimming from 0–100% through push-dim, digital, DMX or analog (0–10 V DC) interfaces. For OEM we offer LED light engines as well as power supplies. We use industry-leading LEDs from Nichia and Lumileds. GVA Lighting distributes our products around the world.

GVA Lighting

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Drivers & control

Heatron Inc

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Web: www.heatron.com

Heatron Inc is a leading-edge integrator of systems and components used in LED lighting applications. Luminaires that are transitioning lighting products from traditional technologies to LEDs utilize Heatron's experience and expertise in the design and assembly of thermal management systems (including printed circuitboards), optics, power sources, connectors and other critical components.

● Optics

Heptagon

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Web: www.heptagon.fi

Heptagon develops, designs and manufactures optics for a variety of LED applications, including mobile phones, LCD TVs, LED-based projectors, and general illumination systems. "A one-stop-shop approach" minimizes risk for customers and accelerates time to market. Heptagon is an ISO9001-certified company.

Heptagon's components are based on novel diffractive and refractive micro-optics. Free-form microstructures on top of a flat substrate enable high efficiency, flexible beam shaping and efficient light mixing for single-die, multi-die, white-light and RGB LED sources. Thin, flat LED microlenses can be formed directly on top of the LED, adding less than 1 mm to the module's thickness.

Heptagon's LED microlenses are produced by a proprietary batch wafer-scale REEMO UV-replication process. This enables low cost in mass-production and high robustness. Materials are available that can withstand a lead-free IR reflow process (temperatures up to 280 °C), long-term storage and humidity, and temperature shocks (in conformance with Telcordia/JEDEC regulations).

HEPTAGON

● Vehicle lighting

Hella KGaA Hueck & Co

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E-mail: ulrich.koester@hella.com
Web: www.hella.com

The automotive supplier Hella mainly develops and manufactures components and systems for lighting and electronics technology. The company is currently implementing headlamps with LEDs as light sources of the future in powerful prototypes. Hella aims to be able to present a full LED headlamp ready for series production by around 2008/2009. In the rear-signal lamp sector, the company has successfully been using LEDs as light sources for more than 10 years now, in high-mounted stop lamps, for example, or for tail-light, stop-light and direction indicator functions in combination rear lamps. Hella is also playing a leading role in the development of interior lighting systems with LEDs.

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● LED packages ● Vehicle lighting

Hitaltech Ltd

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Fax: +44 (0)1253 899 920
E-mail: uksales@hitaltech.com
Web: www.hitaltech.com

Founded in 1986, Hitaltech Ltd is involved in the manufacture and supply of interconnect products, including its flat flexible cable range, which allows the mounting of LEDs. This new and innovative product can be used for a variety of applications in the lighting and automotive industries, among others.

● LED engines & modules ● Packaging ● Drivers & control ● Multiple applications

Hotbeam

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E-mail: sales@hotbeam.com
Web: www.hotbeam.com

Hotbeam is involved in the design, development, manufacture, marketing and distribution of LED-based illumination products for interior and exterior applications. Key products include solar-powered paving lights; the premium TriBrite – halogen replacement MR16 LED lamps; LED modules; LED light fittings; and more.

● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Multiple applications

i2Systems

355 Bantam Lake Road, Morris, CT 06763-1102, USA
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Web: www.i2systems.com

i2Systems is a premier solid-state lighting manufacturer and systems developer. The company leverages its core technologies and expertise to enable integrated LED systems for a broad spectrum of industries.

Aside from its role as an OEM, i2Systems tailors LED-based designs around the specific requirements of its customers. From LED light engines to complete systems, i2systems provides thorough integration of electrical, mechanical, thermal and optical design services and the agility to quickly and successfully bring new designs to market as well as support them once in production.

Through the creation of LED-based retrofits for existing products, i2Systems replaces traditional light sources while requiring little or no modification to the customer's product design and performance. New developments are enabled through end-to-end project management and support, including PCB/MCPCB design and fabrication, thermal analysis, optical and mechanical design, custom LED driver and controller design, product testing and volume manufacturing.

i2Systems™ INTEGRATE. ILLUMINATE.

● Packaging ● Optics ● Illumination

IDEALED

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Fax: +39 0444 349 565
E-mail: info@idealed.it
Web: www.idealed.it

IDEALED offers a comprehensive range of products for LED-based systems. Our company proposes a complete set of optics that our engineers can customize for your systems. A set of IP-patented products and LED systems with clamping and threaded body for interior, architectural and commercial applications complete our offer.

● lumination ● Architectural, entertainment & decorative lighting ● Displays, signs & signals

Illumivision Inc

7224-50th Street, Edmonton, Alberta T6B 2J8, Canada
Tel: +1 888 705 1028
Fax:+1 780 465 7020
E-mail: info@illumivision.com
Web: www.illumivision.com/

Illumivision Inc is a world leader in the design and marketing of high-performance solid-state lighting systems in the areas of architectural and landscape lighting. Illumivision prides its success on the use of SACO/SMARTVISION LED screen technologies in providing the brightest and most powerful LED solutions to date.

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● Architectural lighting ● Vehicle lighting

iLight Technologies Inc

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Web: www.ilight-tech.com

iLight Technologies, Inc is a leading-edge technology company that designs, manufactures and markets the next generation of award-winning products using light-emitting diodes for commercial markets. iLight's products blend the benefits of LEDs with patented application systems that create accent lighting products that have high brightness with a smooth, even glow.

The Plexineon product line offers designers that great, bright neon look without all of its drawbacks. Plexineon linear lighting systems also provide exceptional durability and design flexibility along with inherent energy-efficiency and minimal maintenance requirements.

Plexineon technology is a superior lighting solution for exterior or interior building accents, custom signage, and even specialized OEM applications.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Multiple applications

Infinilux Inc

2030 E Gladwick Street, Rancho Dominguez, CA 90220, USA
Contact: Anthony Vilgiate
Tel: +1 310 561 8546
E-mail: anthony@infinilux.com
Web: www.infinilux.com

Infinilux provides state-of-the-art light engines and drivers to give lighting designers and engineers unlimited design freedom. A wide range of standard products are ready to integrate into your project or proposal. Strip lighting, cove lighting, incandescent replacements and decorative architectural lighting are our specialty. Easy online ordering is available.

● Industry services

Insight Media

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Fax:+1 203 838 8432
E-mail: dian@insightmedia.info
Web: www.insightmedia.info

● Test & measurement

Instrument Systems GmbH

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Fax: 0049 89 454943 11
E-mail: info@instrumentsystems.de
Web: www.instrumentsystems.de

Instrument Systems is the technology and market leader for LED and display measuring systems based on spectroradiometry. Founded in 1986, it develops and manufactures a range of products to determine all relevant optical parameters of LEDs, like luminous intensity (candela), luminous flux (lumen) and the spatial radiation pattern of single LEDs, clusters and modules.

A wide selection of fibre-based measurement adapters are used to create complete turnkey systems for research and industrial applications. These systems conform to the guidelines of the International Commission on Illumination (CIE), and this means that they are able to generate very precise and reliably reproducible results.

Instrument Systems is already supplying the measuring equipment required for analysing the high-power LEDs that are fast becoming a key technology. Instrument Systems provides support for a global customer base with back-up from a comprehensive network of representatives plus a subsidiary in Canada.

Insight Media is a leading market and technology research firm providing its unique Opportunity Analysis for manufacturers and resellers of electronic displays and their components. Insight's Display Daily (a free service – http://displaydaily.com/join.php) provides daily reporting and analysis on breaking news stories in the display and electronics industries.

● Illumination ● Architectural, entertainment & decorative lighting

James Thomas Engineering Ltd (PixelRange)

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E-mail: andy@pixelrange.co.uk
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● Test & measurement

KLA-Tencor

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Tel: +1 408 875 3000
Fax: +1 510 456 2498
E-mail: info@kla-tencor.com
Web: www.kla-tencor.com

The Candela series of optical surface analyzers (OSA) from KLA-Tencor automatically detect and classify surface defects on optoelectronic and semiconductor wafers, even transparent wafers such as sapphire and glass.

OSA systems combine multiple technologies to simultaneously measure reflectivity and topographic variations on the surface, enabling the detection of particles, stains, scratches, pits and bumps. The OSA images can be used for visual inspection or to automatically generate defect maps and reports. Epi layers and film coatings can also be inspected for uniformity, particles and surface defects. These cost-effective products are available with manual or cassette-to-cassette handling of 50–300 mm wafers.

Pioneers in the development of LED lighting, JTE manufactures the PixelRange product portfolio. The fixtures have been specifically developed to meet the different creative demands of lighting designers in both the entertainment and architectural sectors. Products include the PixelLine 1044 and PixelPar 90.

● Architectural, entertainment & decorative lighting

LDDE Vertriebs GmbH

Dreherstrasse 64, A 1110 Vienna, Austria
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Fax: +43 1 7671811 99
E-mail: office@ldde.com
Web: www.ldde.com

LDDE products are developed in close co-operation with light and stage designers, architects and lighting engineers. The synergy of practice-oriented development work and in-house production in combination with a wide range of high-end products of leading manufacturers allows LDDE to respond to the customer's wishes in an individual and flexible manner.

Not listed?

E-mail: joanna.hook@iop.org to be included next time.

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● Light engines & modules ● Drivers & control ● Illumination ● Architectural, entertainment & decorative lighting

LEADER LIGHT sro

M. Gorkeho 33, SK-05201 Spisska Nova Ves, Slovak Republic
Contact: Julius Szaraz, managing director
Tel: +421 2 4445 7511
Fax: +421 2 4445 7525
E-mail: sales@leaderlight.sk
Web: www.leaderlight.sk

Leader Light offers production LED modules, outdoor and indoor luminaires for architectural, entertainment and decorative lighting; OEM production with high-power LEDs; and DMX 512 or DALI power supplies for high-power LEDs for any application.

● Light engines & modules ● Packaging ● Drivers & control ● Multiple applications

LEDdynamics Inc

44 Hull Street, Randolph, VT 05060, USA
Contact: Mason W Alling
Tel: +1 802 728 4533
Fax:+1 802 728 3800
E-mail: sales@leddynamics.com
Web: www.leddynamics.com www.luxdrive.com

LEDdynamics is a custom engineering and manufacturing company specializing in the design and integration of LED technology for end-user and OEM applications. We are he developers of LuxDrive, the smallest constant current LED drivers available in the industry. Single applications, complex arrays and control systems – LEDdynamics delivers solutions that exceed customer expectations.

● Test & measurement

Labsphere Inc

231 Shaker Street, North Sutton, NH 03260, USA
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Tel: +1 603 927 4266
Fax: +1 603 927 4694
E-mail: labsphere@labsphere.com
Web: www.labsphere.com

Labsphere has provided innovative light-measurement technology since 1979. Products include light-measurement systems for LEDs, lasers and traditional light sources; uniform light sources to calibrate imaging devices and camera systems in the visible and IR; and reflectance standards for calibrating spectroscopic measurement systems.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Industry services

LED Giant

PO Box 451, 44 Hull Street, Suite 300, Randolph, VT 05060, USA
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E-mail: sales@LEDgiant.com
Web: www.LEDgiant.com

LED Giant is a distributor of all makes and brands of LED components and the first in the industry to offer online sales of LED products, educational resources, monthly research on industry trends and unbiased comparisons of products available: LEDs; drivers; power supplies; optics; and light engines.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Drivers & control ● Multiple applications

LEDIUM Ltd

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Contact: Csaba Mesterhazy, CEO
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Ledium started the LED business with the trading of LED lightsources and lamps. Nowadays we develop and manufacture RGB floodlights, outdoor luminaries and customer-specific lamps. This year LEDIUM opened to the public homelighting market and advertisement industry.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics

LED Lighting Supply

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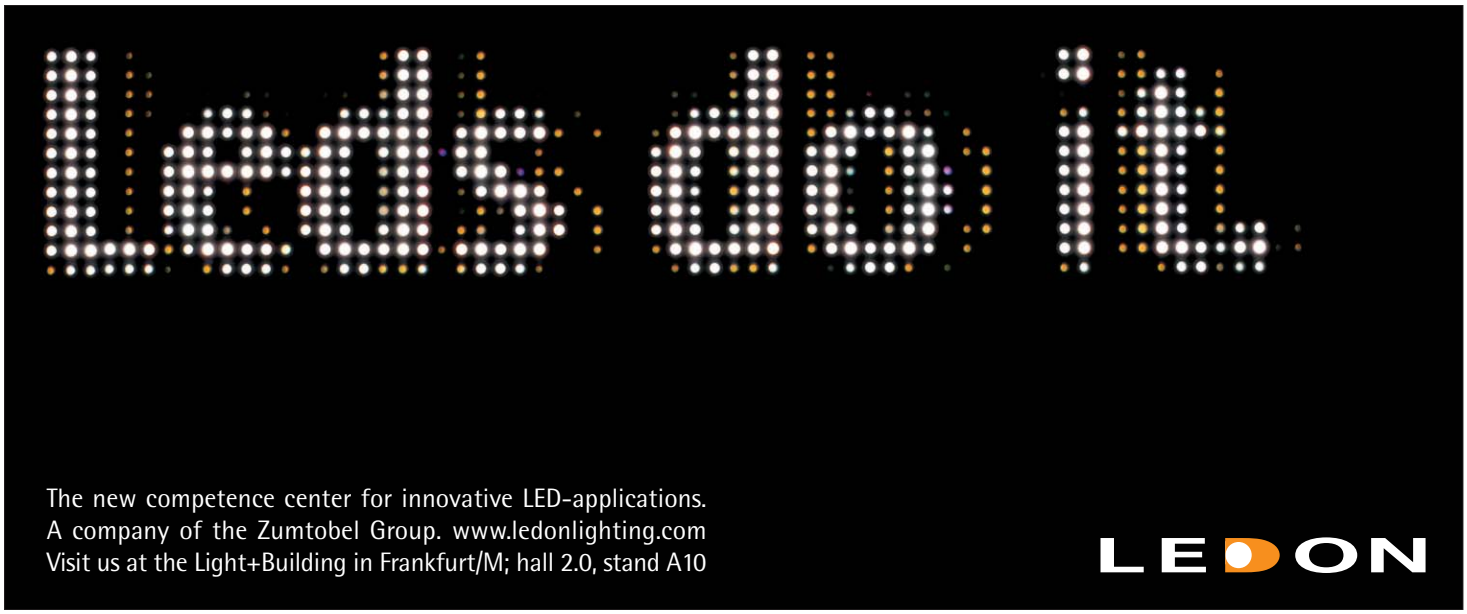
Web: www.LEDLightingSupply.com

LED Lighting Supply is the authorized and exclusive provider of Cree XLamp products for eastern USA, eastern Canada and Mexico. Services include the design and integration of XLamp LED technology for end-user and OEM solutions. We have XLamp LEDs, MCPCB, FR4, drivers and secondary optics knowledge and experience.



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● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers

Lamina

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Tel: +1 609 265 1401
Fax: +1 609 265 9905
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Web: www.laminaceramics.com

Lamina's LED light engines are manufactured by combining high-brightness LEDs from industry-leading LED manufacturers with Lamina's proprietary packaging technology. This technology provides unmatched thermal performance coupled with package interconnectivity and allows Lamina to densely cluster multiple LEDs to achieve exceptionally high luminous intensity in very small footprints. Lamina light engines are available in white, RGB and monochrome up to 100 W, and also in custom packages up to 1000 W. During the past year, Lamina Ceramics set two successive world records for brightness with its Aterion LED light engines in RGB and white – the brightest ever produced – at 13 300 and 28 000 lumens respectively. The company's BL-4000 RGB+ light engine was honored as best technical innovation and was judged the best new LED product at LightFair International 2005, the world's largest architectural and commercial lighting trade show and conference. Lamina's BL-4000 Warm White product was also recognized as a "Platinum Award" winner by ADEX.

lamina®
Bright Lights. Bright Ideas.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Illumination

LED Supply

44 Hull Street, Suite 200, Randolph, VT, 05060, USA
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LED Supply is your premier source for LEDs and LED drivers. You can purchase LUXEON, Cree, Nichia, Osram, Lamina Ceramics and 5 mm LEDs. We also carry products from LuxDrive, LumiDrives, L2 Optics and TerraLUX. LED supply – for all of your LED and LED driver needs. Contact us at sales@ledsupply.com.

● Light engines & modules ● Packaging ● Optics ● Illumination ● High-power LEDs

LED Light for you

E-mail: info@ledlightforyou.com
Web: www.ledlightforyou.com

OSRAM has initiated the network "LED Light for you" to provide an internet platform for information on LEDs in general lighting, pulling together the competences of different partners and helping users to find the solutions to their specific needs.

The platform provides the names of reliable companies and the latest information about all of the components needed to create lighting solutions with LEDs. The aim is to showcase the possibilities of LED technology and support potential customers in finding partners to develop their own solutions.

LED Light for you
powered by OSRAM

● LED packages ● Light engines & modules ● Packaging ● Multiple applications

LEDtronics Inc

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LEDtronics manufactures LED lamps for decorative lighting, industrial plants, automotive, theme parks, gaming and some consumer LED products. Our product line encompasses an array of direct incandescent replacement LED lamps, low-cost snap-in and relampable panel-mount LED lamps, miniature lamps for slot machines and push-button switch applications, sunlight-visible discrete LEDs, PCB LEDs, SMT LEDs, full-spectrum RGB LEDs and IR LEDs.

● High-power LEDs ● LED packages ● LED chips ● Light engines & modules ● Packaging ● Optics

Lexedis Lighting GmbH

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Lexedis Lighting GmbH is a joint venture of TridonicAtco and Toyoda Gosei. As a worldwide leader in research and development, Lexedis revolutionizes the lighting industry by introducing high-efficiency digital light sources and setting new international standards. XED is the unique mark representing this new breakthrough technology.

● Light engines & modules ● Drivers & control ● Illumination ● Vehicle lighting ● Architectural, entertainment & decorative lighting ● Medical, industrial & other

LED Specialists

7A Main Street, Kings Park, NY 11754, USA
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E-mail: info@ledspecialists.com
Web: www.ledspecialists.com

The LED Specialists mission: LED Specialists is an engineering services company specializing in the design and development of innovative and high-performance LED-based lighting solutions. We support our customers with engineering and manufacturing resources to pursue LED product leadership and revenue growth.
We're unique: What makes us unique is the depth of our engineering experience, our robust Product Realization Process and seasoned programme-management skills to ensure project success.
Our experience: Our team has more than 20 years' of combined experience in applying LED technology to lighting applications. We excel in meeting the demands of rugged environmental applications.
Our capabilities: We offer complete product design and development:
Custom LED drivers – optimized for the application
Optical design – to maximize lighting effectiveness
Mechanical design – including housings and thermal management
Rapid prototyping
Project/programme management

LED SPECIALISTS

● Light engines & modules ● Drivers & control ● Illumination ● Architectural lighting

Lumière Technologies

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Our vision is to enhance living spaces making use of power LED white lighting fixtures. We design intelligent sensing, detection, RF communication systems and programmable drivers that work in harmony with LED lighting technology. We distribute, install and specify LED and fiber-optic systems for various international manufacturers in South Africa.

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● Illumination ● Architectural & decorative lighting

Lighting Science Group Corporation

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Lighting Science Group designs and sells LED bulbs and fixtures powered by Optimized Digital Lighting technology, a patented approach to power supply and thermal management, which yields maximum efficiency, enhanced reliablity and longest life from high-brightness LEDs.

Our current product line includes globe bulbs (G11, G25), floodlights (R25, BR30) and ornamental bulbs, such as flametips. Our puck lights and strip lights are being installed as in-cabinet and under-cabinet lighting in major hotels as fire-safe replacements for hot halogen lights.

Our high-output line of low bay and wall pack fixtures are replacing HID fixtures in parking garages and warehouses. During the second half of 2006, we will be introducing our new streetlight line.

High-output fixtures and streetlights are available to qualified customers via our Shared Savings program, which results in no initial costs to the customer. We also design custom solutions for high-volume applications. Contact us for a solution to your lighting problem.

● High-power LEDs ● LED packages ● LED chips ● Light engines & modules ● Packaging ● Drivers & control

Marktech Optoelectronics

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Web: www.marktechopto.com

Marktech is the exclusive North American value-added reseller for Toshiba and Cotco LEDs and Toshiba constant current LED driver ICs. Marktech offers a wide range of ultrabright LEDs, surface mounts, dot matrix and segment displays, along with a complete line of photosensor products.

● High-power LEDs ● LED packages ● Light engines & modules

Lynk Labs Inc

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Fax: +1 847 783 0130
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Web: www.lynklabs.com

Lynk Labs is a leading developer of AC LED technology. Lynk manufactures and supplies AC LED devices, modules, drivers and system level products based on its patented technology. Lynk Labs products improve system costs, efficiency and reliability of LED lighting products. Lynk Labs AC LED technology is an infrastructure solution for LEDs that offers a plug n' play total solution at the system level. Lynk Labs expertise, combined with a global network of partnerships allows Lynk to provide its customers with the highest quality products from devices to complete lighting systems.

● Packaging

Midwest Circuits

2206 Burdette Street, Ferndale, MI 48220, USA
Contact: Raj Patel
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Fax: +1 248 548 9721
E-mail: Midwest01@aol.com
Web: Midwestcircuit.com

We manufacture metal clad printed circuitboards using up to 3 oz copper and various thicknesses of aluminum substrate. We can also formulate a custom dielectric for either optimal thermal impedance or withstanding voltage. Additional services of populating boards and the optimal design of a power supply, based on the application.

● High-power LEDs ● LED packages ● LED chips

NICHIA Chemical Europe GmbH

Westerbachstraße 30, 61476 Kronberg, Germany
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Web: www.nichia.de

● Packaging ● Drivers & control

Magtech Industries Corporation

5625-A South Arville Street, Las Vegas, Nevada 89118, USA
Tel: +1 702 364 9998
Fax: +1 702 364 1562
E-mail: csupport@magtechind.com
Web: www.magtechind.com

Magtech Industries Corporation was founded in 1990 with manufacturer facilities in Taiwan and China. We specialize in designing and manufacturing high-quality switch-mode power supplies/drivers for the LED luminaries applications.

Magtech offers a comprehensive range of switch-mode drivers for high-power/high-brightness LED lighting systems in both full-range AC and low-voltage DC input. The product offering ranged from 3 to 240 W with "constant current" and "constant voltage" output in various packages. We are also capable of providing total assembly and packaging solutions, and contract manufacturing for LED assemblies.

Full-range and power factor corrected AC input, C/C and C/V outputs, compact size and innovated damp/wet locations packaging are the key features in our designs, which provide the ultimate convenience for all LED lighting applications.

Having "Ever researching for a brighter world" as our motto, Nichia developed and commercialized the high-brightness blue LED in 1993. Since then, nitride-based LEDs in different emission colors ranging from ultraviolet to yellow have been contributing to the diversification of LED application fields. We hope that Nichia continues to be a company that will be able to make a contribution to the world by evolving its original and unique technologies into production.

● Light engines & modules ● Illumination ● Architectural lighting

NuaLight Ltd

Unit 3, Airport East Business Park, Kinsale Road, Cork, Ireland
Contact: Paul O'Shaughnessy, sales and marketing manager
Tel: +353 21 484 9062
E-mail: info@nualight.com
Web: www.nualight.com

LED Luminaires offers advanced cabinet lighting solutions for the retail industry: proprietary CryoLED illumination for temperature-controlled display cases, JewelLED for jewelry display cases, AmbiLED for domestic applications and custom solutions to OEM customer requirements.

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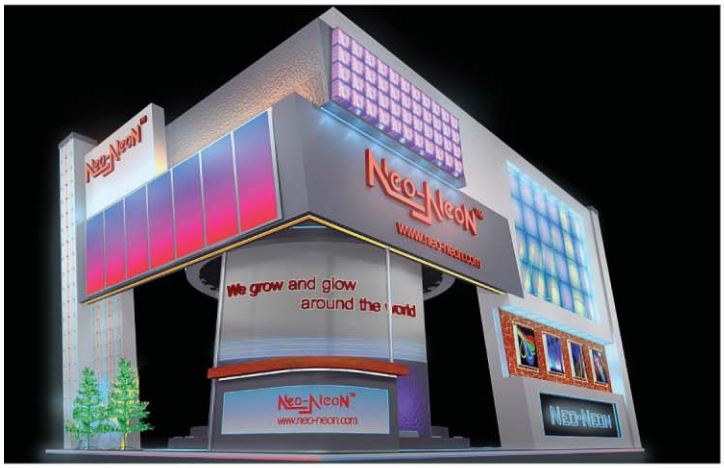
Neo-Neon™

WE GROW AND GLOW AROUND THE WORLD

Since 1979, Neo-Neon has led the decorative lighting industry. Today, we move our steps into LED commercial lighting industry. After years of Research & Development and considerable investment in LED technology, we are now able to offer a wide range of LED products in the categories listed below. In future, we will continue listen to you and put your ideas into our innovations……

Hospitality Design Asia 2006

Hong Kong Convention & Exhibition Centre on 28,29th June 2006
Hall 5A, Booth No.: 121,123,125,220 & 222



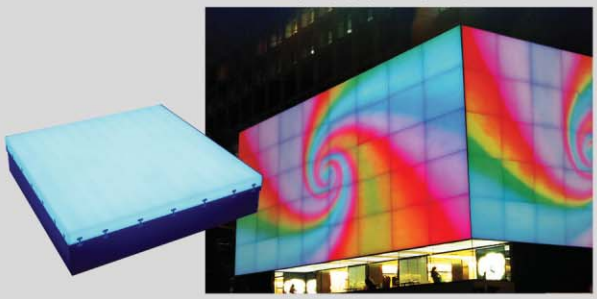
Light & Building 2006

Messe Frankfurt GmbH, Ludwig-Erhard-Anlage 1, 60327 Frankfurt am Main Germany on 23-27th April 2006, Hall 4, Booth No.: 4.1 H50

WORLDWIDE PATENTED

LEDPane series

LED Video Pane series



LED Pane Light series

LED Battery-Charged Umbrella Light

LED Lamp series

CN-250216

LED Street Light series ▸

Neo-Neon is proud to launch LED Streetlight series, which is an excellent substitution for traditional streetlight.
LED streetlight is not only brightening road and pavement, but also is a new stylish decoration in any place. LED streetlight has 3 Color Temperature for you choice (2700k, 3200k, 4000k), which enable best suitable choice in different locations. You can also choose our Solar Energy option, with this style; you get additional advantage of NO electrical cost at all.


Double light

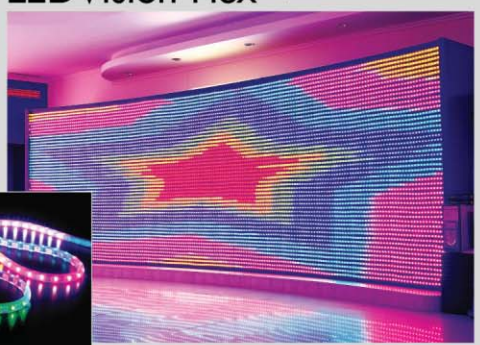

Double light with solar


Single light with solar

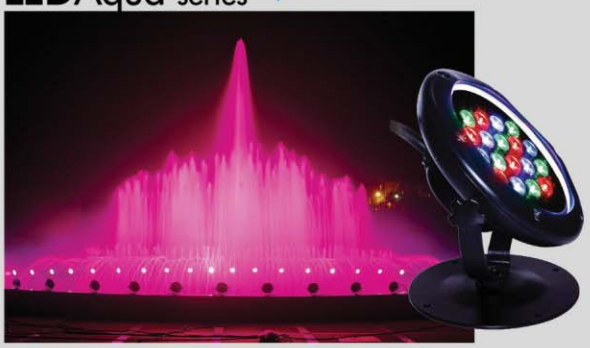

Single light

WORLDWIDE PATENTED

LEDVision-Flex ▾



LEDAqua series ▾



LEDNeon series ▾

LEDWall Washer series ▾

Neo-Neon Holdings Ltd.

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CN-250217

● Drivers & control

Maxim Integrated Products

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Maxim offers a wide range of LED driver ICs for applications including portable products (cellphones and PDAs), signage, general lighting, automotive interior/exterior lighting and RGB LED applications, such as LCD TV backlight and RPTV. Maxim's years of experience developing power management ICs and advance silicon processing capability allows cost-effective LED drivers with accurate current-mode control and digital tunability. Established in 1983, Maxim Integrated Products is a worldwide leader in the design, development and manufacture of linear and mixed-signal integrated circuits. Headquarters is located in Sunnyvale, California.

● Packaging

NuSil Technology

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Web: www.nusil.com

NuSil Technology is a cutting-edge manufacturer of silicone compounds for the photonics industry, developing products that require precise, predictable, cost-effective materials performance. NuSil's Lightspan brand product line is the most extensive for index-matching applications. ISO-9001 certified since 1994, NuSil operates state-of-the-art laboratories and processing facilities in North America and Europe, and it provides on-site, in-person application engineering support worldwide.

● Illumination ● Architectural, entertainment & decorative lighting ● Displays, signs & signals

ODECO

Carretera N-II Km 636, 08019 Badalona, Barcelona, Spain
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Fax:+34 933 41 21 33
E-mail: sales@odeco.com
Web: www.odeco.com

● High-power LEDs ● LED packages ● LED chips ● Light engines & modules ● Packaging ● Test & measurement ● Illumination ● Displays, signs & signals

MBK Microtek Inc (Mitsui Group)

Shuwa Shiba Park Building, A-10F, 2-4-1 Shibakoen, Minatoku, Tokyo 105-0013, Japan
Contact: Taku Iima, manager
Tel: +81 3 5733 0701
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E-mail: t.iima@mbk-microtek.co.jp
Web: www.mbk-microtek.co.jp

With a wealth of experience arranging strategic business alliances and creating value in the solid state lighting industry, and over 10 years working with some of the world's leading manufacturers of InGaN LEDs, we play an important role in the marketing and distribution of LED products (chips, lamp modules and other equipment) and the development of new markets worldwide through the Mitsui global group network headquartered in Japan.

ODECO GROUP is made up of a group of companies specializing in LED systems applications. They manufacture and commercialize two ranges of LED screens – SMARTVISION and ODECO – two brands firmly positioned in the LED video displays market with applications in road traffic, sports, advertising, corporate communication and entertainment.

● Drivers & control

ON Semiconductor

8 rue des Frères Caudron BP 114, 78148, Velizy cedex, France
Contact: Technical Information Center
Tel: +421 33 790 2910
Enquiries: www.onsemi.com/PowerSolutions/ticrequest.do
Web: www.onsemi.com

ON Semiconductor offers over 15 000 semiconductors IC and discrete for solving the toughest problems of power management and power distribution, and it addresses in particular the lighting power management market. Whether your power source is an AC mains, low-voltage AC/DC or coming from a battery, our drivers can meet your LED lighting needs.

● Test & measurement

Optronic Laboratories

4632 36th Street, Orlando, FL 32811, USA
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Tel: +1 407 422 3171
Fax: +1 407 648 5412
E-mail: info@olinet.com
Web: www.olinet.com

● Drivers & control ● Vehicle lighting

Melexis NV

Rozendaalstraat 12, 8900 Ieper, Belgium
Tel: +32 (0)13 670 495
E-mail: sales@melexis.com
Web: www.melexis.com

Melexis' Power LED driver family offers ICs optimized for performance, flexibility, robustness and cost. All ICs are designed for automotive interior and exterior applications but can generically be used in all high-volume single or power LED array applications that require temperature compensation, low noise and high efficiency at the lowest possible system cost.

Melexis (Euronext Brussels: MELE) designs, develops, tests and markets advanced integrated semiconductor devices. For over a decade our customers in the automotive electronics market have inspired us to create, manufacture and deliver advanced mixed signal semiconductors, sensor ICs and programmable sensor IC systems. The company sells its products to a wide customer base of automotive system manufacturers in Europe, North America and Asia.

Melexis' products include microcontrollers, Hall (magnetic), optical sensor ICs, interface ICs for pressure and acceleration sensors, micromachined silicon pressure, acceleration and gyroscope sensors, application-specific integrated circuits, wireless communication (RF) and RFID components, in each case principally for automotive applications.

For over 30 years, Optronic Laboratories Inc has designed and manufactured industrial and research-grade light-measurement instrumentation for science, industry and the military. Whether our equipment is used in metrology labs, quality control or R&D, clients are guaranteed the industry's highest-quality LED test and measurement systems and accessories that provide consistent, traceable and precise optical radiation measurements throughout the long life of the instrumentation.

● High-power LEDs ● LED packages

OSRAM Opto Semiconductor GmbH

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E-mail: pr@osram-os.com
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● High-power LEDs ● LED packages ● Packaging ● Optics ● Drivers & control ● Illumination ● Mobile appliances ● Architectural, entertainment & decorative lighting ● Display signs & signals

Neo-Neon International Ltd

Gong He Town, He Shan City, Guangdong, China 529 728
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Tel: 86 13 828 023 290
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Tel: 86 13 680 416 048
Contact: Jong Jang, Europe division
Tel: 86 13 902 556 414
E-mail: sales@neo-neon.com
Web: www.neo-neon.com

Neo Neon International Ltd was founded in Taiwan in 1978. It is a major producer of hi-tech light-emitting diode decorative illumination products worldwide. Neo-Neon offers a comprehensive range of products, including LED Neon-flex, LED Vision-flex, wall washer, decorative lights and home decor. Neo-Neon employs 200 engineers and spends 5–8% of its revenue on R&D each year, obtaining more than 350 patents in Taiwan, Japan, the USA, Hong Kong and Australia. Please feel free to contact us for more information.

Neo-NeoN™

OSRAM Opto Semiconductors GmbH, Regensburg, is a wholly owned subsidiary of OSRAM, one of the world's three largest lamp manufacturers, and offers its customers a range of solutions based on semiconductor technology for lighting, sensor and visualization applications. The company operates facilities in Regensburg (Germany), San José (USA) and Penang (Malaysia).

● High-power LEDs ● LED packages ● Illumination

Para Light Corp

515 Spanish Lane, Suite B, Walnut, CA 91789, USA
Contact: Amy Chung
Tel: +1 909 468 4866
Fax: +1 909 468 4876
E-mail: sales@paralight.us
Web: www.paralight.us

Para Light has 20 years of experience in LED innovation. Para Light offers cost-effective ultra-bright LED, LED display, SMD LED display, SMD LED, housing LED, enhanced power LED, IR LED and more. It is ISO 9002 and QS 9000 certified, and RoHS compliant.

● High-power LEDs ● LED packages ● Light engines & modules ● Illumination

NeoPac Lighting

8F, No. 136, Hsien-Chien 3rd Street, Chu-Bei City, Hsinchu 302, Taiwan
Contact: Melissa Chiang, sales
Tel: +886 3 558 3620
Fax: +886 3 558 6909
E-mail: melissa@neopac-lighting.com
Web: www.neopac-lighting.com

NeoPac Lighting is a leader in ultra-high-power LED-enabling technology and has been setting industry standard for brightness output. We add colors to the future of LED lighting. Our specialty is in general lighting at ultra-high-power level (6 W/package up to 30 W/package), offering single packaged LED NeoBulb light engines. NeoPac is the world's first to offer single-packaging design with eight LED power chips for the NeoPac emitter, much can provide mixing white and RGB variable colors for general illumination. We are at the forefront of LED solid-state lighting, providing plug-and-play system-in-a-package LED lighting products and efficient heat management through our proprietary NeoPac thermal module design. The president and CEO of NeoPac Lighting is Jeffrey Chen.

NeoPac®

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging

PerkinElmer Elcos

Luitpoldstrasse 6, 85276 Pfaffenhofen, Germany
Tel: +49 8441 8917 0
Fax: +49 8441 7191 0
E-mail: elcos.sales@perkinelmer.com
Web: http://optoelectronics.perkinelmer.com

PerkinElmer Elcos, a leading provider of innovative LED solutions for medical, specialty lighting and automotive applications, has over 25 years of experience in COB technology, manufacturing and supplier partnerships. We offer UV, visible to IR, standard SMD and custom products. The ACULED, our new RGB LED platform, delivers superior color mixing and brightness.

● Illumination ● Architectural, entertainment & decorative lighting

Permlight Products

422 West Sixth Street, Tustin, CA 92780, USA
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E-mail: mwebb@permlight.com
Web: www.permlight.com

● Test & measurement ● Industry services

National Physical Laboratory

Hampton Road, Teddington, Middlesex TW11 0LW, UK
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Fax: +44 (0)20 8943 6283
E-mail: paul.miller@npl.co.uk
Web: www.npl.co.uk/optical_radiation/

The National Physical Laboratory (NPL) is a world-leading centre in the development and application of highly accurate measurement techniques. As the UK's national standards laboratory, NPL underpins the national measurement system, ensuring consistency and traceability of measurements throughout the UK.

The Optical Radiation Measurement (ORM) team in NPL's Quality of Life Division have wide-ranging interests covering research and development from ultraviolet to infrared radiation.

ORM provides optical source characterization and calibration of continuous and pulsed light sources, including LEDs and LED clusters, over a spectral range of 290 nm to 1100 nm, including the assessment of LED hazard. We measure luminous flux, luminous intensity, spectral radiance and many other parameters. Additionally, consultancy can be provided for your specialized needs such as designing instrumentation, running training courses and classifying devices to customer or international standards.

NPL are UKAS-accredited for testing to IEC 60825-1 and EC 60825-2, and can test components against CIE S009.

NPL National Physical Laboratory

Permlight Products is a leading developer and manufacturer of thermally managed LED lighting systems for signage (LED channel letters), residential LED lighting under the ENBRYTEN brand name (including recessed cans, under cabinet, and LED glass pendants), marina applications (docks/slips), and theater and performing arts center lighting. Founded in 1995, Permlight has the longest track record of supplying LED lighting systems that provide high brightness, low energy, long lifetime and low maintenance.

● High-power LEDs ● LED packages ● LED chips ● Light engines & modules ● Mobile appliances ● Vehicle lighting

Philips Lumileds Lighting Company

370 W. Trimble Road, San Jose, CA 95131, US
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E-mail: info@philipslumileds.com
Web: www.philipslumileds.com

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● Packaging

Nye Lubricants Inc

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Tel: +1 508 996 6721
Fax: +1 508 997 5285
E-mail: bholley@nyelubricants.com
Web: www.nyeoptical.com

SmartGels serve as encapsulants for high-brightness LEDs. They are designed to increase lumen output, extend lumen life and survive demanding operating conditions. Unlike optical epoxies, SmartGels provide a pliable connection between rigid parts, taking up the differential thermal expansion without inducing excessive stresses or delamination. They are "crystal clear" throughout visible wavelength, with a typical optical absorption of <0.001%/μm. They're manufactured, filtered and deaerated in a clean- room environment to ensure they are free from light-absorbing microscopic particulates.

SmartGels are "taught" how to work in your LEDs and adapt to your production environment:

- the refractive index of the gel is matched to the refractive index of your lens;
- the cured consistency is matched to your specs, from gelatin-like with self-healing characteristics to hard silicone rubber;
- the pot life is set to meet your production requirements – from a few minutes to many hours.

SmartGels can also be formulated to resist water, ionizing radiation, reactive chemicals, yellowing at soldering temperatures and more. Every SmartGel is designed for reliability and long service life.

SmartGel
It knows how to make the light shine through

Philips Lumileds is the world's leading manufacturer and only high-volume producer of power LEDs. The company pioneered the use of power LED lighting solutions for everyday purposes, including automotive lighting, computer displays, LCD televisions, signage and signaling, and general lighting. LUXEON LEDs enable never-before-possible lighting solutions.

● Test & measurement

Photon Inc

6878 Santa Teresa Boulevard, San Jose, CA, 95119-1205, USA
Contact: Mary Russell, marketing coordinator
Tel: +1 408 226 1000
Fax: +1 408 226 1025
E-mail: beam@photon-inc.com
Web: www.photon-inc.com

● Test & measurement

Ocean Optics Inc

830 Douglas Avenue, Dunedin, FL 34698, USA
Tel: +1 727 733 2447
Fax: +1 727 733 3962
E-mail: info@oceanoptics.com
Web: www.oceanoptics.com

Ocean Optics offers an LED-measurement system for determining absolute spectral intensity values (in watts, joules, lumens or candela), color parameters (including X, Y, Z and L*, a*, b*) and features such as dominant wavelength, peak wavelength, centroid and FWHM. Designers and manufacturers of LEDs use the system to ensure consistency in spectral output and color.

At the heart of each LED measurement system is a miniature fiber-optic spectrometer that the user calibrates with a NIST-traceable light source. Users can configure complete systems by simply adding an integrating sphere to collect light from the LED, optical fiber to carry the light to the spectrometer, a NIST-traceable power supply to adjust and display the power supply drive current, and software to make sense of it all. Because all of the LED system components are modular, users are not limited to one set of operating parameters and can easily optimize a system for their application.

Ocean Optics Inc. First in Photonics™

Photon Inc is a leading producer of instruments to measure the spatial characteristics of light and light sources. Photon has a line of goniometric radiometers that are suited to measuring the light-emission patterns of both packaged and bare chip LEDs to help optimize fiber coupling and light source design.

● LED chips ● Optics ● Mobile appliances

Photonix Limited

Block 7, Kelvin Campus, West of Scotland Science Park, Glasgow G20 0TH, UK
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Web: www.photonix.org.uk

Photonix Limited is a compound semiconductor growth and fabrication facility. It owns a fully equipped cleanroom and offers custom LED fabrication. The InGaN and GaAlAs reactors of the universities of Strathclyde and Glasgow are located here. The facility has been used since 1999 to fabricate both InGaN and AlGaInP chips.

● High-power LEDs ● LED packages ● LED chips ● Packaging ● Mobile appliances ● Vehicle lighting

OPTEK Technology

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Web: www.optekinc.com

OPTEK Technology is a leading manufacturer of standard and application-specific sensors using infrared, visible, magnetic and fiber-optic technologies focused on applications in office machines, industrial equipment, encoders, automotive electronics, military and high-reliability applications, and medical diagnostic equipment. Headquartered in Carrollton, Texas, the company is ISO/TS16949:2002 and BS EN ISO 9001:2000 certified, as well as ITAR registered. OPTEK Technology was acquired by TT Electronics in December 2003.

OPTEK

● Drivers & control

Power Integrations Inc

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Fax: +1 408 414 9201
E-mail: eurosales@powerint.com
Web: http://www.powerint.com

Power Integrations Inc is the leading supplier of high-voltage analog integrated circuits (ICs) used in AC–DC and DC–DC power conversion. Its DPA-Switch family of ICs is targeted at DC-to-DC applications for distributed power systems and constant current converters required for LED applications.

● Light engines & modules ● Packaging ● Vehicle lighting ● Displays, signs & signals ● Medical, industry & other

PRP Optoelectronics Ltd

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Fax: + 44 (0)1327 359 602
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Web: www.prpopto.com

PRP is a leading supplier of custom displays for avionic and ground-based applications, optical overlays, reprographics and medical applications. Hybrid displays can be multicolour, sunlight visible, include onboard electronics and have over 10 000 pixels. Linear and xy monolithic arrays have more than 2000 individual emitters from 10 μm across.

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● High-power LEDs ● LED packages ● LED chips ● Light engines & modules ● Optics ● Drivers & control ● Multiple applications

OSRAM GmbH

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As a global player in the general lighting and optosemiconductor market, OSRAM has core competence in developing and manufacturing LEDs, including electrical, thermal and optical design. OSRAM provides a range of powerful, complete LED systems, including OPTOTRONIC electronic gear and light-control systems for architectural indoor and outdoor lighting, shoplighting, accent and decorative lighting, and illuminated advertising.These innovative LED systems are the ideal basis for creative ideas and new lighting solutions.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Multiple applications

RICHARD SCHAHL GmbH&Co KG

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We are an LED solutions provider with 40 years' special lighting experience combined with deep LED knowledge. We offer the best LED solutions for any application; co-operation with market leaders; high-power LEDs, LED light engines and modules; integrated LED solutions (standard or custom specific); optics, drivers and controllers; project business with complete LED fixtures.

● Medical, industry and other

SCHOTT North America Inc

Fiber Optics Division, 62 Columbus Street, Auburn, NY 13021, USA
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Web: www.us.schott.com/fiberoptics

● Optics ● Mobile appliances ● Displays, signs & signals

Polymer Optics Ltd

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E-mail: info@polymer-optics.co.uk
Web: www.polymer-optics.co.uk

Polymer Optics Limited designs and manufactures precision plastic optical components and has been successfully producing optics for use with LED devices since 1998. It also has a comprehensive standard range of optics available off the shelf, including the efficient compact individual hexagon and seven-cell cluster optics. It provides volume manufacture from several sites worldwide. Core capabilities are:

- product design and development – including LED optics, lightguides, beacons, medical systems, underwater lighting, camera flash, signals, signage, backlighting
- optical design, analysis, test – for optimum system efficiency and light control;
- optical tooling and manufacture – for volume production, rapid prototyping;
- project management.

SCHOTT offers a broad product portfolio. Our LED product platforms include ring lights, controllers, minicontrollers, light sources and light lines in a wide variety of sizes, shapes, colors and spectral ranges. SCHOTT specializes in providing LED or fiber-optic custom solutions to meet any application.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Multiple applications

Selectronic Ltd

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Fax: +44 (0)1993 772512
E-mail: NicolaP@selectronic.co.uk
Web: www.selectronic.co.uk
Web: www.selectronic-led-lights.com

Selectronic has been involved in LEDs for over 25 years and can supply both standard and custom LED solutions to meet all indication, lighting and display applications. We can support engineering and drive demands and deliver tailored solutions, in volume, in prompt lead times, where required. Ensure the right LED solution by contacting Selectronic.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Illumination

Presto Electronics

Freemantle House, Kingsclere Park, Kingsclere, Newbury, Berkshire RG20 4SW, UK
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Fax: +44 1635 291 391
E-mail: info@presto.co.uk
Web: www.presto.co.uk

Presto Electronic Components Limited is a UK agent and distributor of electronic products, representing a small selection of world-class manufacturers located throughout Europe, the USA and the Far East.

We are a technically focused distributor concentrating primarily on the design of value-added components, modules and systems. Our product portfolio offers a diverse range of optoelectronic products and services, comprising high-power LEDs, standard and custom high-power LED modules, light engines, optics, thermal management solutions, driver ICs and driver modules. We maintain a first-class level of support throughout the project lifetime, providing technical assistance where needed, working with our suppliers to ensure that our customers receive the best support for their selected product ranges.

If you wish to discuss a particular project or would like further information about our product range then please contact our sales department.

● Illumination

SolarOne Solutions

51 Marble Street, Framingham, MA 10702, USA
Contact: Moneer Azzam, president
Tel: +1 508 620 7652
Fax:+1 508 620 7650
E-mail: info@solarone.net
Web: www.solarone.net

Using white LEDs and our proprietary controls, our solar-powered lighting systems produce the most cost-effective, energy-efficient and high-quality overhead light for sidewalks, pathways, bus shelters and parking lots. With even distribution and a wide beam spread, these lights offer security and amenity without the cost of trenching.

Not listed?

E-mail: joanna.hook@iop.org

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● LED packages ● LED chips ● Light engines & modules ● Drivers & control ● Multiple applications

ROHM Electronics

10145 Pacific Heights Boulevard, Suite 1000, San Diego, California 92121, USA
Tel: +1 888 775 ROHM
Fax: +1 858 625 3640
E-mail: marketing76@rohmelectronics.com
Web: www.rohmelectronics.com

ROHM is a leading manufacturer of IC and semiconductor products, with its headquarters located in Kyoto, Japan. ROHM's LED product line includes an ultrabright LED series that incorporates an original four-element (AlGaInP) compound.

ROHM's latest full-color dot-matrix LED units take advantage of an exclusive potting lens-development technology that results in greater readability and viewing contrast. Incorporating a 1024-level grayscale driver for each color (red, green, blue), these modules are capable of producing up to a billion colors – producing the highest-quality color expressions in a variety of visual formats.

ROHM develops its own production system so that it can focus on specific aspects of customized product development. This allows ROHM the flexibility to take on a wide range of applications and projects to better serve valuable clients in the automotive, telecommunications and computer sectors, as well as consumer OEMs.

● Light engines & modules ● Drivers & control ● Vehicle lighting ● Displays, signs & signals

SoundOff Signal

3900 Central Parkway, Hudsonville, MI, 49426, USA
Contact: Thomas J Palumbo, vice president sales and marketing
Tel: +1 616 896 7100
Fax: +1 616 896 1286
E-mail: sales@soundoffsignal.com
Web: www.soundoffsignal.com

We are a manufacturer of emergency and commercial vehicle safety products. Markets served are law enforcement and first responders, school and transit buses, as well as heavy-duty truck industries. Our LED lighting products include a wide selection of high-output warning, signal and marker lights.

Not listed?

E-mail: joanna.hook@iop.org to be included next time.

● Packaging ● Optics

Shin-Etsu Chemical

6-1, Ohtemachi 2-chome, Chiyoda-ku, Tokyo, Japan
Tel: +81 3 3246 5134
Fax: +81 3 3246 5361
E-mail: silicone-led@shinetsu.jp
Web: www.silicone.jp

Shin-Etsu Chemical Co Ltd is a global innovator of advanced technology polymers and products leading to successful development and commercialization of high-intensity LED products.

We offer hard and soft silicone encapsulants, coatings, die-bonding materials and thermal interface materials. We can also provide design and application expertise at the device and module level. Our products provide high refractive index, high transmittance, excellent resistance to discoloration and high durability in severe aging and thermal cycle environments. Our encapsulants range in Shore D hardness from 50 to 80. We also offer soft gel products for stress-sensitive applications.

Shin-Etsu specializes in providing solutions to your most taxing LED design challenges. Please contact us at our e-mail address. For our catalog of materials for LED devices, go to our home page, "catalog download", "other products", and select "silicones for photo devices".

● High-power LEDs ● LED packages ● LED chips ● Light engines & modules ● Packaging ● Optics ● Mobile appliances ● Vehicle lighting

Stanley Electric

Atrium Court, The Ring, Bracknell, Berkshire RG12 1BW, UK
Tel: + 44 (0)1344 393 053
Fax: + 44 (0)1344 393 153
E-mail: sales@stanley-electric-eu.com
Web: www.stanley-components.com

Stanley Electric is a world-leading manufacturer of LEDs and other optoelectronic devices. With cutting-edge development, excellent design and technical expertise, together with world-class manufacturing capabilities, we support clients from the automotive, mobile phone and lighting industries, and beyond. Contact us today for more information.

● Illumination

Starled Inc

1050 E. Dominguez Street, Unit P, Carson, CA 90746, USA
Tel: +1 310 603 0403
Fax: +1 310 603 1335
E-mail: sales@starled.com
Web: www.starled.com

● LED chips

Tekcore Co Ltd

No. 18, Tzu-Chung 3rd Road, Nan-Kung Industrial Zone, Nantou, Taiwan, ROC
Contact: Sharon Lin, marketing manager
Tel: +886 49 226 1626
Fax: +886 49 226 1635
E-mail: sales@tekcore.com.tw
Web: www.tekcore.com.tw

Tekcore is specialized in manufacturing high-quality nitride-based high-brightness blue, green and UV LED chips and wafers.

Starled Inc is a leading global designer and manufacturer of standard and custom incandescent replacement LED lamps, panel lights and circuitboard status indicators.

● Industry services

Strategies Unlimited

201 San Antonio Circle, Suite 205, Mountain View, CA 94040, US
Contact: Tim Carli, sales manager
Tel: +1 650 941 3438, ext 23
Fax:+1 650 941 5120
E-mail: tcarli@strategies-u.com
Web: www.strategies-u.com

Founded in 1979, Strategies Unlimited is the premier provider of market research reports and custom consulting services in the high-brightness LED market, as well as other optoelectronic component markets. It also sponsors the highly regarded annual LED industry conference Strategies in Light.

● Driver ICs

Supertex

1235 Bordeaux Avenue, Sunnyvale, CA 94089, USA
Tel: +1 800 222 9883
Fax: +1 408 222 4800
E-mail mktg@supertex.com
Web: www.supertex.com

Supertex is a producer of high-voltage analog and mixed-signal semiconductors and ICs, which we design, develop, manufacture and market for the telecommunications, networking system, flat-panel display, and medical and industrial electronic industries. Our process technologies have enabled us to penetrate emerging markets such as the high-brightness LED arena, where the number of applications and the demand for LEDs continue to grow significantly.

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● Light engines & modules ● Packaging ● Drivers & control

Universal Science

16 Walker Avenue, Stratford Office Village, Wolverton Mill, Milton Keynes MK12 5TW, UK
Contact: James Stratford
Tel: +44 (0)1908 222 211
Fax: +44 (0)1908 222 212
E-mail: jamess@universal-science.com
Web: www.universal-science.com
The Netherlands: Ad Musters
Email: Adm@universal-science.com
Tel: +31 (0)35 523 9209
Fax: +31 (0)35 523 1438
France: Sebastien Manceau
Email: Sebastienm@universal-science.com
Tel: +33 (0)144 92 92 15
Fax: +33 (0)144 92 92 28

Universal Science is dedicated to developing and manufacturing new products and services to solve thermal management issues present in electronic assemblies. Universal Science supports the traditional lighting companies that may not fully understand high-power LED lighting technology (which is effectively a power semiconductor) but wish to employ this new and exciting technology. Those lighting companies wishing to own a product range in LED lighting can be confident in the knowledge that their LED lighting units have been properly designed and built to the highest standards. Universal Science has a dedicated design and manufacturing service for LED light fixtures to service this market. We have introduced many traditional lighting companies to LED technology and produce designs in which they can be confident.

UNIVERSAL SCIENCE

● LED packages ● Light engines & modules ● Optics ● Drivers & control ● Multiple applications

TECNILITE

Rua Gonçalves Zarco, 3320, 4455-822 Santa Cruz do Bispo, Matosinhos, Portugal
Tel: +351 2299 62800
Fax: +351 2299 62039
E-mail: info@tecnilite.com
Web: www.tecnilite.com

TECNILITE is a leading supplier of LED components, optics, drivers and control equipment. We offer a comprehensive range of systems for architectural, entertainment and decorative lighting. Intelligent LED clusters provide vibrant and exciting LED effects in signs and many other applications. TECNILITE offers strong support in design, installation and maintenance.

● LED packages ● Light engines & modules ● Packaging ● Optics ● Multiple applications

US A'SYCK Corporation

One Park Plaza, Suite 600, Irvine, CA 92614, USA
Contact: Ray Ponkey, director sales and marketing
Tel: +1 248 345 7795
Fax: +1 248 305 5764
E-mail: r.ponkey@usasyck.com
Web: www.usasyck.com
Contact: Tomo Kuribayashi, COO
Tel: +1 949 833 7123
Fax: +1 949 833 7124
E-mail: t.kuribayashi@usasyck.com

US A'SYCK is a high-quality optoelectronics manufacturing company, vertically integrated from component to subassembly to complete assembly products.

Our products include three-chip multicolor SMT LEDs, alphanumeric and dot matrix LED displays and modules, illuminated switches and backlight modules for the amusement and gaming industries, custom-molded LED products for the automotive and test and measurement industries, and LED products for the general lighting industries.

Our company mission is the development of new products with high quality and reliability while responding to our customers' needs in a timely manner by providing technical development in all stages of the process from research, development, manufacturing and support. The corporate structure of our privately held and small company allows us the flexibility to respond to our customers' needs with speed and precision.

A'SYCK

● LED packages ● LED chips ● Medical, industry & other

The Fox Group Inc

200 Voyageur Street, Point-Claire, Quebec H9R 6A8, Canada
Tel: +1 925 980 5645
Fax:+1 514 630 0227
E-mail: sales@thefoxgroupinc.com
Web: www.thefoxgroupinc.com

Fox Group manufactures nitride-family products:
Blue LEDs: 460 nm wafers, chips, lamps, SMD
UV LEDs: 350–355 nm and 360–365 nm wafers, chips, lamps, SMD
We sell standard-size and 1 × 1 mm power chips, plus LEDs in standard and custom packages. Fox Group also offers aluminum nitride (AlN) substrates for deep-UV applications.

● High-power LEDs ● LED packages ● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Multiple applications

Vossloh-Schwabe Optoelectronic GmbH & Co KG

Carl-Friedrich-Gauß-Str. 3, 47475 Kamp-Lintfort, Germany
Tel: +49 2842 980 0
Fax: +49 2842 980 299
E-mail: marketingvsw@vsw.vossloh-schwabe.com
Web: www.vs-optoelectronic.com

VS Optoelectronic, which is headquartered in Kamp-Lintfort, Germany, is part of the Vossloh-Schwabe Matsushita Electric Works Group, known for its excellent product line and technological know-how in the utilization of LEDs in the lighting industry. With more than 25 years of experience in the field of LED technologies and a vast range of LED modules, controls and connector technologies, VS Optoelectronic is the competent and experienced partner in finding solutions that are the perfect match to customers' requirements.

VS Optoelectronic applies COB, SMD and T-type technologies as well as high-power LED solutions. In particular, innovative chip-on-board technology enables chip densities of up to 70 chips/cm^2. This innovation is well suited when there is a need of miniaturization and opens up new and fascinating areas of applications.

VS Optoelectronic is approved according to DIN EN ISO 9001 and ISO 14001.

VS Optoelectronic
A New Lighting Experience

● Light engines & modules ● Architectural, entertainment & decorative lighting

TIR Systems Ltd

7700 Riverfront Gate, Burnaby, BC V5J 5M4, Canada
Tel: +1 604 294 8477
Fax: +1 604 294 3733
E-mail: info@tirsys.com
Web: www.tirsys.com

TIR is a world leader in solid-state lighting products and technology. Besides our ColorTrace and Destiny products, TIR developed LEXELTM – the first fully integrated LED-based light source, designed specifically to produce high-quality white light for general lighting. LEXEL is positioned to become a new standard in global lighting.

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● Light engines & modules ● Packaging ● Optics ● Drivers & control ● Multiple applications

Tri-O-Light BV

Hermesweg 23, 3771 ND Barneveld, the Netherlands
Tel: +31 342 450 506
Fax: +31 342 450 232
E-mail: info@triolight.nl
Web: www.triolight.com

Tri-O-Light is a supplier and manufacturer of LED and fiber-optic products. The total plug-and-play product range consists of LED light strip, chain LED system, LED ground and wall spots, LED modules and spots (Luxeon), metal core printed circuitboards, LED lamps, LED floodlights and Astro fibre-optic starry sky systems.

● Architectural, entertainment & decorative lighting

Tryka LED Ltd

The Sycamores, 43 Kneesworth Street, Royston, Hertfordshire SG8 5AB, UK
Tel: +44 (0)1763 244 133
Fax: +44 (0)1763 241 116
E-mail info@tryka.com
Web: www.tryka.com

Tryka LED Ltd is a UK-based company manufacturing high-quality, high-power LED luminaires and fixtures. The Tryka range has a host of products for almost any application, including both interior and exterior fixtures and even underwater units for fountains and swimming pools.

● LED chips

Tyntek Corporation

1387 Ren-Ay Road, Chunan-Jenn, Miaulih 350, Taiwan, ROC
Contact: Richard
Tel: +886 37 582997 ext 122
Fax: +886 37 582908
E-mail: richard@serv.tyntek.com.tw
Web: www.tyntek.com.tw

Tyntek is a manufacturer of LED chips and silicon products (photodiode, phototransistors, zenerdiode) in Taiwan with a total capacity of around 1200 million chips per month and a worldwide market share of around 16%. We are well educated and experienced engineers, and we co-operate with R&D institutes and universities so that we can ensure that customers always get what they need, and we provide total solutions.

Not listed?

E-mail: joanna.hook@iop.org to be included next time.

● Drivers & control ● Mobile appliances ● Vehicle lighting

Zetex Semiconductors plc

Zetex Technology Park, Chadderton, Oldham OL9 9LL, UK
Tel: +44 (0)161 622 4444
Fax: +44 (0)161 622 4446
E-mail: lighting@zetex.com
Web: www.zetex.com

Zetex Semiconductors provides LED driver ICs tackling a range of applications, from LCD backlighting and automotive tail-lights to building illumination and digital camera flash.

Purpose designed to drive high luminance white LEDs, the Zetex boost and buck converters ensure highly accurate continuous current control and offer efficiencies as high as 95%.

Small package size combined with high power dissipation is another hallmark of Zetex LED drivers. The use of miniature packages such as the TSOT23-5 and the SC70-6 helps to address the space limitations of even the smallest portable consumer electronics.

Renowned for their high integration and versatility, the Zetex LED drivers present an elegant design platform, which is easily configured to suit the needs of specific applications through a simple change in external components.

With its power efficient transistors and diodes, Zetex can also offer a more complete LED driving solution for higher voltage, higher current switching applications.

ZETEX SEMICONDUCTORS

● Illumination ● Architectural, entertainment & decorative lighting ● Displays, signs & signals

Zumtobel Lighting

Unit 4, The Argent Centre, Pump Lane, Hayes, Middlesex UB3 3BL, UK
Tel: +44 (0)20 8589 1800
Fax: +44 (0)20 8756 4800
E-mail: enquiries@zumtobel.com
Web: www.zumtobel.co.uk

Innovative lighting solutions create added value in terms of ergonomics, economic efficiency, environmental compatibility and aesthetics. Zumtobel Lighting is the worldwide leader in electronic lighting technology and professional lighting systems. Whether new building or redevelopment project, we guarantee our partners customer-oriented advice, tailor-made solutions and comprehensive service.

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HIGH-POWER LEDS

High-power LEDs

American Bright
AP Technologies
Avago Technologies
Binay Opto Electronics
Bivar
Citizen Electronics
CML Innovative Technologies
Cree LED Light
Data Display Products
Dialight Lumidrives
EBV (Avago, Osram, Toshiba)
Enfis
ETG Corporation
E Wave
Guang Li
Harvatek
Heatron
Infinilux
Lamina Ceramics
LED Giant
LED Lighting Supply
LED Supply
Lexedis Lighting
Lynk Labs
Marktech Optoelectronics
MBK Microtek (Mitsui)
Neo-Neon International
NeoPac Lighting
NICHIA Chemical Europe
OPTEK Technology
OSRAM GmbH
OSRAM Opto Semiconductor
Para Light Corp
PerkinElmer Elcos
Philips Lumileds Lighting
Presto Electronics
Richard Schahl
Selectronic
Stanley Electric
Tecnilite
VS Optoelectronic

LED PACKAGES

Through-hole LEDs

ACOL Technologies
American Bright
AP Technologies
Avago Technologies
Binay Opto Electronics
Bivar
CML Innovative Technologies
Data Display Products
EBV (Avago, Osram, Toshiba, Vishay)
ETG Corporation
E Wave
Guang Li
Harvatek
LED Supply
LEDtronics
Lynk Labs
Marktech Optoelectronics
MBK Microtek (Mitsui)
Neo-Neon International
NICHIA Chemical Europe GmbH
OPTEK Technology
OSRAM GmbH
OSRAM Opto Semiconductor
Para Light Corp
Philips Lumileds Lighting
Presto Electronics
Richard Schahl
ROHM Electronics
Selectronic
Stanley Electric
Tecnilite
The Fox Group
VS Optoelectronic

Surface-mount LEDs

American Bright
AP Technologies
Avago Technologies

OPTRONIC LABORATORIES
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Bivar
Citizen Electronics
CML Innovative Technologies
Cree LED Light
Data Display Products
EBV (Avago, Osram, Vishay)
Enfis
ETG Corporation
E Wave
Guang Li
Harvatek
Heatron
Hitaltech
Lamina Ceramics
LED Giant
LED Supply
LEDtronics
Lexedis Lighting
Lynk Labs
Marktech Optoelectronics
MBK Microtek (Mitsui)
Neo-Neon International
NICHIA Chemical Europe GmbH
OPTEK Technology
OSRAM GmbH
OSRAM Opto Semiconductor
Para Light Corp.
PerkinElmer Elcos
Philips Lumileds Lighting
Presto Electronics
Richard Schahl
ROHM Electronics
Selectronic
Stanley Electric
Tecnilite
The Fox Group
US A'SYCK
VS Optoelectronic

White LEDs

ACOL Technologies
American Bright
AP Technologies
Avago Technologies
Binay Opto Electronics
Bivar
Citizen Electronics
CML Innovative Technologies
Cree LED Light
Data Display Products
EBV (Avago, Osram, Toshiba, Vishay)
Enfis
ETG Corporation
Evident Technologies
Harvatek
Heatron
Infinilux
Lamina Ceramics
LED Giant
Ledium
LED Lighting Supply
LED Supply
LEDtronics
Lexedis Lighting
Lynk Labs
Marktech Optoelectronics
MBK Microtek (Mitsui)
Neo-Neon International
NeoPac Lighting
NICHIA Chemical Europe
OPTEK Technology
OSRAM GmbH
OSRAM Opto Semiconductor
Philips Lumileds Lighting
Presto Electronics
Richard Schahl
ROHM Electronics
Selectronic
Stanley Electric
Tecnilite
The Fox Group
VS Optoelectronic

Phosphors

Evident Technologies

AC LEDs

Lynk Labs

LED CHIPS

AlGaInP LED chips

EBV (Avago, Osram)
ETG Corporation
E Wave
Marktech Optoelectronics
OPTEK Technology
OSRAM GmbH
OSRAM Opto Semiconductor
Philips Lumileds Lighting
Photonix Limited
ROHM Electronics
Selectronic
Stanley Electric
Tyntek

Infrared LED chips

AP Technologies
EBV (Osram, Vishay)
ETG Corporation
E Wave
Marktech Optoelelctronics
OPTEK Technology
OSRAM GmbH
OSRAM Opto Semiconductor
Photonix Limited
ROHM Electronics
Selectronic
Stanley Electric
Tyntek

Nitride (InGaN) LED chips

American Bright
Cree LED Light
EBV (Avago, Osram, Toshiba, Vishay)
ETG Corporation
E Wave
Lexedis Lighting
Marktech Optoelectronics
MBK Microtek (Mitsui)
NICHIA Chemical Europe GmbH
OSRAM GmbH
OSRAM Opto Semiconductor
Philips Lumileds Lighting
Photonix Limited
ROHM Electronics
Selectronic
Tekcore Co Ltd
The Fox Group
Tyntek

LIGHT ENGINES & MODULES

Chip-on-board modules

AB Mikroelektronik
Allaeys LED Instruments
American Bright
AP Technologies
Avago Technologies
Binay Opto Electronics
Bivar
CML Innovative Technologies
Color Kinetics
EBV (Avago, Osram)
Elumina Technology
Enfis
GVA Lighting
Harvatek
Heatron
i2Systems
Lamina Ceramics
Leader Light
LEDtronics
Lexedis Lighting
Lynk Labs
Marktech Optoelectronics
MBK Microtek (Mitsui)
NuaLight
OSRAM GmbH
PerkinElmer Elcos
Presto Electronics
PRP Optoelectronics
Richard Schahl
ROHM Electronics
Selectronic
SoundOff Signal
Stanley Electric
Tecnilite
Tri-O-Light
Universal Science
US A'SYCK
VS Optoelectronic

Custom modules & design services

AB Mikroelektronik
AlbEO Technologies
Allaeys LED Instruments
American Bright
ANC Sports Enterprises
AP Technologies
Apticol
Avago Technologies

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OPTICS

Optical design software & services

Optics, lenses, diffusers, etc

DRIVERS & CONTROL

Driver ICs

Drivers

Power supplies & electronic loads

TEST & MEASUREMENT

Test & measurement equipment

Standards testing laboratories

INDUSTRY SERVICES

Industry groups

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Market research

Insight Media
LED Giant
Strategies Unlimited

ILLUMINATION

Lighting design

Advanced LEDs Ltd
Binay Opto Electronics
Bivar
CML Innovative Technologies
Crescent Lighting
Data Display Products
EBV (Osram)
ECIE Engineering
EcoLEDLighting
EREA
GVA Lighting
Hotbeam
James Thomas Engineering
Leader Light
LED Light for you
Lumière Technologies
Neo-Neon International
OSRAM GmbH
Selectronic
Tri-O-Light

Desk lamps

AlbEO Technologies
Binay Opto Electronics
DGA
ECIE CITYLights
Hotbeam
i2Systems
Ledium
LEDtronics
Lumière Technologies
Neo-Neon International
ODECO
OSRAM GmbH
Selectronic
Tecnilite

Flashlights & lanterns

Apticol
Binay Opto Electronics
Citizen Electronics
CML Innovative Technologies
Cyberlux
ECIE CITYLights
EcoLEDLighting
Hotbeam
i2Systems
LED Supply
LEDtronics
Lighting Science Group
Neo-Neon International
ODECO
OSRAM GmbH

General area lighting

AB Mikroelektronik
Advanced LEDs Ltd
AlbEO Technologies
Apticol
Binay Opto Electronics
Bivar
CML Innovative Technologies
Crescent Lighting
Cyberlux
DGA
Dialight Lumidrives
EBV (Osram)
ECIE CITYLights
EcoLEDLighting
E Wave
Guang Li
GVA Lighting
Hotbeam
i2Systems
Illumivision
Infinilux

Supertex HV9911:
Driving Solutions
for High Brightness LEDs!

Ideal for RGB backlight and automotive lighting applications, the HV9911 uses a closed loop control scheme to deliver high output current accuracy. This efficient and versatile part can be used not only in boost topologies, but also in buck and fly-back configurations.

Features:
- Internal transconductance operational amplifier
- Slope compensation
- Fixed frequency or fixed off-time operation
- PWM and linear dimming

For more information or to request samples of the HV9911, visit:
http://www.supertex.com/go/leds0206

Supertex inc.
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Leader Light
Ledium
LED Light for you
LEDtronics
Lighting Science Group
Lumière Technologies
Neo-Neon International
NeoPac Lighting
NuaLight
ODECO
OSRAM GmbH
Permlight Products
Richard Schahl
Selectronic
SolarOne
Tecnilite
Tri-O-Light

LED bulbs

AlbEO Technologies
American Bright
Applelec Sign Components
Binay Opto Electronics
CEZOS
CML Innovative Technologies
Color Kinetics
Data Display Products
EBV (Osram)
Elumina Technology
Enfis
E Wave
Guang Li
Hotbeam
i2Systems
IDEALED
Infinilux
LEDdynamics
LED Specialists
LED Supply
LEDtronics
Lighting Science Group
Neo-Neon International
NeoPac Lighting
NuaLight
OSRAM GmbH
Para Light Corp.
Presto Electronics
Richard Schahl
Selectronic
Stanley Electric
Starled
Tecnilite
Tri-O-Light
US A'SYCK
VS Optoelectronic

Solar-powered lights

Advanced LEDs Ltd
Binay Opto Electronics
ECIE CITYLights
EcoLEDLighting
Elumina Technology
Hotbeam
i2Systems
LEDtronics
Neo-Neon International
OSRAM GmbH
Selectronic
SolarOne

Streetlights

DGA
Advanced LEDs Ltd
Binay Opto Electronics
Dialight Lumidrives
EcoLEDLighting
i2Systems
Leader Light
LEDtronics
Lighting Science Group
Neo-Neon International
NuaLight
OSRAM GmbH
Selectronic
SolarOne
Stanley Electric
Tecnilite

MOBILE APPLIANCES

LEDs & components for mobile

austriamicrosystems
Avago Technologies
BFi Optilas
Bivar
Citizen Electronics
CML Innovative Technologies
Elumina Technology
Harvatek
LEDdynamics
Marktech Optoelectronics
MBK Microtek (Mitsui)
OPTEK Technology
OSRAM GmbH
ROHM Electronics
Selectronic
Stanley Electric

Backlighting units for mobile

American Bright
Avago Technologies
CML Innovative Technologies
Harvatek
Neo-Neon International
OSRAM GmbH
Photonix Limited
Polymer Optics Ltd
ROHM Electronics
Selectronic
Stanley Electric
US A'SYCK
VS Optoelectronic

Camera flash modules

Avago Technologies
CML Innovative Technologies
OSRAM GmbH
Philips Lumileds Lighting
ROHM Electronics
Stanley Electric

VEHICLE LIGHTING

LEDs & components for vehicles

AB Mikroelektronik
austriamicrosystems
Avago Technologies
BFi Optilas
Binay Opto Electronics
Bivar
Carclo Technical Plastics
CML Innovative Technologies
Data Display Products
ECIE srl
Elumina Technology
Hella
Hitaltech
i2Systems
Infinilux
LEDdynamics
Marktech Optoelectronics
Melexis
ODECO
OPTEK Technology
OSRAM GmbH
Philips Lumileds Lighting
PRP Optoelectronics
ROHM Electronics
Selectronic
SoundOff Signal
Stanley Electric

Interior/exterior vehicle lighting

AB Mikroelektronik
Binay Opto Electronics
CML Innovative Technologies
ECIE srl
Hella
i2Systems
iLight Technologies
Infinilux
LED Specialists
ODECO
OSRAM GmbH
Philips Lumileds Lighting
ROHM Electronics
Selectronic
SoundOff Signal
Stanley Electric
US A'SYCK

ARCHITECTURAL, ENTERTAINMENT & DECORATIVE LIGHTING

Border/contour lighting

AB Mikroelektronik
Advanced LEDs Ltd
AlbEO Technologies
Binay Opto Electronics
CML Innovative Technologies
Color Kinetics

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Crescent Lighting
Cyberlux
Data Display Products
DGA
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EcoLEDLighting
E Wave
GVA Lighting
Hotbeam
i2Systems
iLight Technologies
Illumivision
Infinilux
Leader Light
Ledium
LEDtronics
Lighting Science Group
NuaLight
ODECO
OSRAM GmbH
Richard Schahl
Selectronic
Tecnilite
TIR Systems
Tryka L.E.D. Ltd

Floodlights, wall-washers, battens

Advanced LEDs Ltd
AlbEO Technologies
Apticol
Binay Opto Electronics
CML Innovative Technologies
Color Kinetics
Crescent Lighting
DGA
Dialight Lumidrives
EcoLEDLighting
E Wave
GVA Lighting
Hotbeam
i2Systems
Illumivision
Infinilux
James Thomas Engineering
LDDE Vertriebs GmbH
Leader Light
LEDdynamics
Ledium
LEDtronics
Lighting Science Group
Lumière Technologies
Neo-Neon International
NuaLight
ODECO
OSRAM GmbH
Richard Schahl
Selectronic
Tecnilite
TIR Systems
Tri-O-Light
Tryka LED Ltd

Marker lights

DGA
AB Mikroelektronik
Advanced LEDs Ltd
Binay Opto Electronics
Citizen Electronics
CML Innovative Technologies
Crescent Lighting
EBV (Osram)
EcoLEDLighting
GVA Lighting
Hotbeam
i2Systems
Illumivision
Infinilux
Ledium
LEDtronics
Lumière Technologies
Neo-Neon International
NuaLight
ODECO
OSRAM GmbH
Permlight Products
Selectronic
Tecnilite
Tri-O-Light
Tryka LED Ltd
US A'SYCK
VS Optoelectronic

Wall & floor panels, spheres and other shapes

Advanced LEDs Ltd
Binay Opto Electronics
CML Innovative Technologies
Color Kinetics
DGA
Dialight Lumidrives
EcoLEDLighting
Guang Li
i2Systems
Illumivision
Infinilux
Leader Light
Neo-Neon International
ODECO
OSRAM GmbH
Selectronic
Tecnilite
Tri-O-Light
Tryka LED Ltd
VS Optoelectronic

Holiday & decorative lights

Binay Opto Electronics
Citizen Electronics
CML Innovative Technologies
Color Kinetics
DGA
EcoLEDLighting
Elumina Technology
Illumivision
Leader Light
LED Specialists
LEDtronics
Lighting Science Group
Neo-Neon International
OSRAM GmbH
Selectronic
Tecnilite
Tri-O-Light
Tryka LED Ltd

DISPLAYS, SIGNS & SIGNALS

Alphanumeric displays

Amercan Bright
Avago Technologies
Bivar
Citizen Electronics
CML Innovative Technologies
Dialight Lumidrives
ETG Corporation
Euro Display
Harvatek
Marktech Optoelectronics
Neo-Neon International
ODECO
PRP Optoelectronics
ROHM Electronics
Selectronic
Stanley Electric
Tecnilite
US A'SYCK
VS Optoelectronic

Backlights for large LCD displays

Advanced LEDs Ltd
Avago Technologies
CML Innovative Technologies
Elumina Technology
Enfis
LEDtronics
OSRAM GmbH
Polymer Optics Ltd
ROHM Electronics
Selectronic
Stanley Electric
VS Optoelectronic

Channel letter modules

AlbEO Technologies
American Bright
Applelec Sign Components
Binay Opto Electronics
CML Innovative Technologies
Color Kinetics
Dialight Lumidrives
EBV (Osram)
Elumina Technology
Euro Display
GVA Lighting
Hotbeam
Ledium
LEDtronics
MBK Microtek (Mitsui)
Neo-Neon International
OSRAM GmbH
Richard Schahl
Selectronic
Stanley Electric

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Tecnilite
Tri-O-Light
VS Optoelectronic

Electronic message centers

ANC Sports Enterprises
Euro Display
ODECO
ROHM Electronics
Selectronic
Tecnilite

Exit & emergency signs

ODECO
Binay Opto Electronics
CML Innovative Technologies
Ledium
LEDtronics
Neo-Neon International
Selectronic

Full-color video displays

ANC Sports Enterprises
Applelec Sign Components
Barco
Color Kinetics
Daktronics
Euro Display
Guang Li
Illumivision
MBK Microtek (Mitsui)
Neo-Neon International
ODECO
ROHM Electronics
Selectronic
Stanley Electric

Light sources for projection systems

Apticol
Enfis
E Wave
OSRAM GmbH
Richard Schahl
Selectronic

Variable message signs

Advanced LEDs Ltd
ANC Sports Enterprises
Daktronics
Euro Display
Neo-Neon International
ODECO
ROHM Electronics
Selectronic
Tecnilite

Beacons, emergency directional aids

Binay Opto Electronics
Citizen Electronics
CML Innovative Technologies
Cyberlux
Dialight Lumidrives
EcoLEDLighting
ETG Corporation
Euro Display
i2Systems
Illumivision
LEDtronics
Neo-Neon International
ODECO
Selectronic
SoundOff Signal
Stanley Electric

Railroad, marine, airport signals

ODECO
Binay Opto Electronics
CML Innovative Technologies
Data Display Products
Dialight Lumidrives
EcoLEDLighting
Elumina Technology
ETG Corporation
i2Systems
Infinilux
LED Specialists
LEDtronics
ROHM Electronics
Selectronic
Stanley Electric
Tri-O-Light

Roadway marking & safety lighting

Advanced LEDs Ltd
Binay Opto Electronics
CML Innovative Technologies
Dialight Lumidrives
ECIE CITYLights
EcoLEDLighting
Elumina Technology
ETG Corporation
Euro Display
i2Systems
Illumivision
LEDtronics
Neo-Neon International
ODECO
Selectronic
Stanley Electric
Tri-O-Light

Traffic & pedestrian signals

ODECO
Binay Opto Electronics
CML Innovative Technologies
Dialight Lumidrives
ECIE CITYLights
Elumina Technology
ETG Corporation
Guang Li
i2Systems
LEDtronics
Selectronic
Stanley Electric

MEDICAL, INDUSTRIAL & OTHER

Inspection lighting

Binay Opto Electronics
Data Display Products
EcoLEDLighting
Enfisi2Systems
E Wave
Infinilux
LEDtronics
Schott North America
Selectronic
Stanley Electric
US A'SYCK
VS Optoelectronic

Machine vision lights

Binay Opto Electronics
Data Display Products
ECIE CITYLights
Enfis
i2Systems
Infinilux
LEDtronics
Schott North America
Selectronic
Stanley Electric
VS Optoelectronic

Medical & dental lighting

Binay Opto Electronics
Data Display Products
Enfis
i2Systems
LEDtronics
Schott North America
Selectronic
Stanley Electric

Phototherapy lighting

Binay Opto Electronics
CML Innovative Technologies
Enfis
i2Systems
PRP Optoelectronics
Schott North America
Stanley Electric

UV curing lights

Binay Opto Electronics
CML Innovative Technologies
Enfis
Infinilux
LEDtronics
OSRAM GmbH
Stanley Electric
The Fox Group

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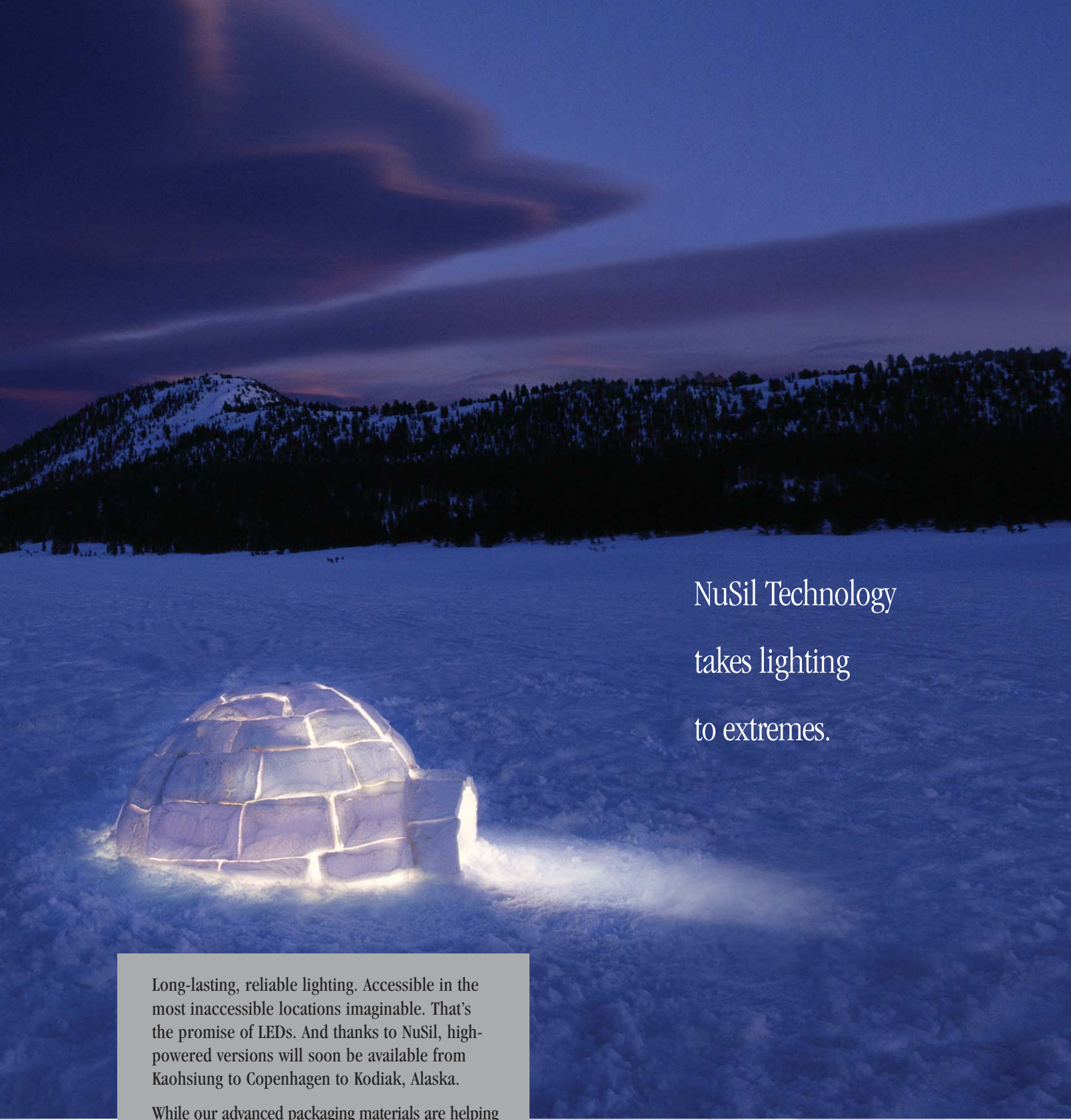

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What? When? Where? If it's NuSil, it's no problem.

NuSil SILICONE TECHNOLOGY

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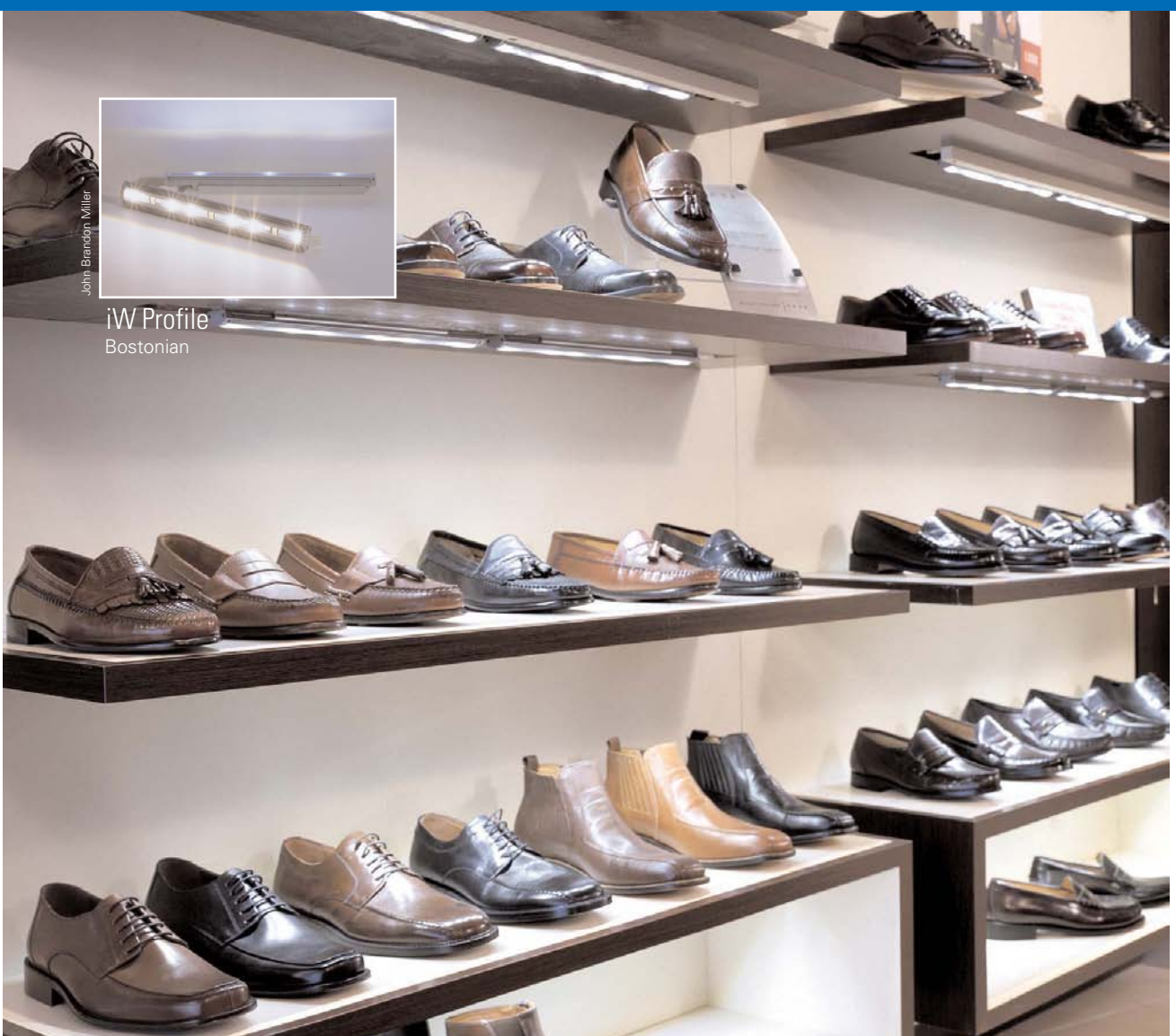
environments
through the
dynamic use of
light



John Brandon Miller

iW Profile
Bostonian

...and now the
dynamic use of
white

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