LED Lighting Solutions Powered by Innovative Electronic Technologies

An in-depth look into how synergistic electronics, optical and lighting industries are yielding new and award-winning technologies to revolutionize the world of LED luminaires.

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Global awareness has heightened government and corporate initiatives to reduce carbon emissions, thereby elevating demand for sustainable lighting sources that deliver energy savings over traditional lighting. Estimates are that lighting accounts for 19 percent of global energy consumption and demand for artificial light will grow 80 percent by 2030. New Solid-State Lighting (SSL) technology is lending a helping hand and could potentially reduce lighting energy consumption 50 percent by 2025.

LEDs drive paradigm shift toward sustainable solutions

LEDs are driving a paradigm shift away from traditional incandescent lights toward energy efficient, longer life and sustainable solutions. From street lights to giant video screens, from car headlights to indoor illumination, SSL systems offer compelling benefits and are already making strides toward transforming the industry. Today’s advanced LED lighting technologies can deliver the sustainability, scalability, and design flexibility that OEMs need to engineer competitive solutions for the SSL residential, commercial and industrial markets.

In addition, LEDs are more physically robust than the average incandescent or CFL light source. With no filament to break, LEDs can withstand heavy vibration, shock and impact better than traditional lamps. Aesthetically, LEDs are dimmable and have the advantage of instant-on capability, with good color rendering and a full color spectrum. They operate silently on a low voltage current, without mercury or lead, and are completely safe for UV sensitive applications. The development of white light LEDs offers a more appealing presentation for an even wider array of applications as LED technology moves beyond the early adoption stage.

Intrinsic design and manufacturing challenges of traditional LED technology

Despite these advantages, there are challenges intrinsic to LED technologies. For example, while LEDs run significantly cooler than incandescent lamps, without proper thermal management their effective service life can be shortened considerably due to heat build-up within the LED junction. Conversely, with the proper thermal management, LED fixtures can last an impressive 50,000 hours at 70 percent lumen maintenance under normal usage.

LED emitters have typically been soldered to PCBs and assembled to integrated fixtures, without a mechanism to replace a failed LED or update the LED. This assembly approach poses several challenges to the fixture manufacturer, being closer to an electronics assembly than a typical lighting fixture. Even well-established fixture manufacturers can struggle with light sources that are actually electronic components requiring a secure connection to an electronic circuit. Successfully soldered designs still leave solder joints vulnerable to stress during handling. A cold solder joint can result in scrapping a high cost LED array.

The LED lighting industry effectively converged into the electronic component space, requiring different expertise that did not yet exist. As a result, LED product development was initially slow, because the industry was rightly cautious about investing heavily in fixtures that cannot be easily assembled, repaired or upgraded. Fixture manufacturers accustomed to traditional lighting have consistently demanded LED modules that more closely emulate traditional lighting.

By combining best-in-class electrical, thermal and optical expertise with in-house design and manufacturing capabilities, Molex stepped up to address these practical design issues and needs. The resulting range of Molex LED light modules provides unprecedented design flexibility and freedom for OEMs to differentiate their product...
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offered. The modular LED lighting solutions are a familiar model long used by distributors, who are now able to broaden their portfolios beyond traditional light sources to include LED sources. Advances in electronic technologies are for the first time making LED luminaire practical and affordable for mass-production.

Helieon® for high-volume applications can deliver energy savings up to 80 percent

Released in March 2010, the Helieon LED light module combines SSL technology from Bridgelux with interconnect technology from Molex. An easy-to-use two-piece design, the Helieon light socket or lamp holder is permanently fastened into the luminaire. The light module is inserted into the socket with a push to make the electrical connections and an intuitive quarter turn to lock the module in place. By emulating a traditional lighting socket, the Helieon system delivers an easy and familiar installation experience. Helieon was designed for lighting OEMs intent on driving mass-market adoption of LED lighting.

Available in a choice of 800- or 1200-lumen output, Helieon modules are rated roughly comparable to 60W and 90W incandescent bulbs, but use significantly less electricity. Modules come in a choice of 3000K warm white or 4100K neutral white color temperatures, and include a choice of 24°, 32°, or 50° beam angles. The module is 80 mm in diameter or just over three inches. With the light module mated to the socket, the assembly measures 27.6 mm or just over an inch thick.

Product options are tailored to match light output levels of traditional light sources, delivering between 500 and 1,500 lumens under application conditions in halogen and fluorescent color temperature options. Helieon modules are available with narrow and medium flood-beam patterns that enable precision effects for a wide variety of lighting applications. Users can readily alter the beam angle, color temperature or light output without removing or replacing the luminaire. Simply switching out the module (with an easy turn) can lend an entirely new look and feel to a lighting installation design.

Helieon delivers to interior and exterior luminaire manufacturers effortless installation, interchangeability, and upgradeability. The simple plug-and-play modular solution allows manufacturers to adopt SSL into their luminaires, with a flexible path forward at a low price point. Luminaire designers can use Helieon to develop products in which the LED source can be easily replaced and upgraded, and do so at price points that offer short payback periods for SSL installations.

The socketed, interconnect Helieon interface enables lighting fixture manufacturers globally to develop products based on the technology, allowing for faster industry adoption. Limited only by one’s imagination, Helieon applications might include down lights, task or accent lights, spot and track lights, troffers and interior-area lighting, retail and display lighting, hospitality lighting, architectural lighting, decorative lighting, and even museum lighting. Supporting industry standardization of the module interconnect technology will help to ensure long-term design opportunities, while protecting the development investment of fixture OEMs and their customers.

LED Array Holder eliminates hand soldering and simplifies LED installation

In 2010, in addition to launching Helieon in partnership with Bridgelux, Molex also launched the solderless LED Array Holder designed for Bridgelux ES and RS arrays. A perfect complement, the LED array holder delivers the same high performance and plug-and-play design in a cost-effective SSL solution. An innovative interconnect system, the LED array holder simplifies the installation of LED assemblies, and facilitates upgrades when more efficient or brighter lights become available. Solderless LED array holders dramatically increase connectivity options for superior design flexibility allowing OEMs to focus on fixture design with fewer constraints and less concern about implementation.

The double-ended wire-trap terminal simplifies assembly, allowing flexibility in wire orientation to achieve optimal wire routing. The releasable wire trap enables field replacements and facilitates upgrades to current applications. The one-step solderless screw down connection system eliminates the need for wire soldering. Surface Mount Technology (SMT) soldering or other secondary processing during assembly, for substantial manufacturing savings and efficiencies. The LED array holder entirely eliminates the need for hand soldering or SMT soldering and expensive SMT equipment.

Secure compression power contacts provide a stable connection even in high-ambient temperature and prevent potential failures due to cold or unreliable solder joints. Other standard features include built-in mounting points for secondary optics. An optional clear LED protective cover, with a snap-lock, protects the LED from dust and assembly process handling.

Because there is no secondary processing required, the Molex array holders help facilitate quick design cycles and ease system-level integration challenges for OEMs. A form factor smaller than 50.00 mm (1.96”) in diameter makes the LED array holder ideal for lamp and other small-fixture applications, including MR16 or track lighting. The thermoplastic housing withstands high heat-generating environments.

Leveraging LED printed circuit assemblies for seamless lighting subassemblies

LED printed circuit assemblies offer a dependable and efficient custom lighting solution that works seamlessly with the Helieon product line for LED subassemblies across numerous industries. Connector and LED design integration equates with a complete solution leveraging proven products and technologies to support total LED interconnect needs. In-house functional testing of all printed circuit assemblies ensures quality and consistency of intensity and color.
Innovative Insights

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Unparalleled circuit board reliability and design blends electrical, mechanical, thermal, and optical function into a fully qualified LED package. Molex custom LED assemblies support backlighting applications with polyester circuits that support lower power consumption applications and heat sinked polyimide and rigid boards to support high power consumption applications, such as surgical and automotive lighting. A BIN control system regulates consistent lot-by-lot LED luminosity output ranges, which are critical in a quality lighting product.

Intelligent lighting controls for network integration and reduced power consumption

As LED adoption progresses, the integration of lighting control systems with network devices will likely play an integral role in energy cost reduction, allowing end users greater flexibility and control over their environment. Intelligent lighting controls are already making jobs easier, while lowering the carbon footprint. New commercial, industrial and residential buildings are incorporating local area networks directly into lighting systems to monitor maintenance requirements, determine occupancy, and offer daylight controls and light dimming systems yet a few more simple and effective ways for OEMs to harness electronic technology to drive down LED power consumption.