LED LIGHTING SOLUTIONS

Powered by innovative electronic technologies

By Dan McGowan

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

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.

Energy savings—a cornerstone of LED technology

Conservatively, LEDs last more than 25 times—ranging up to 40 times longer than incandescent and five times longer than CFLs (compact fluorescent lamps).

In addition, LEDs are more physically robust than the average incandescent or CFL light source and are dimmable with 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.

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. 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.

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 offerings. 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 luminaires practical and affordable for mass-production.

Helieon® for high-volume applications delivers 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 temperature, 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 1500 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.

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
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 helps ensure quality and consistency of intensity and color.

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 sinks 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 cost for both fixtures and electrical applications. 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.

One aspect of driving down the cost of LED lighting is reducing the expense associated with the LED driver circuit, which is said to account for approximately 20% of the overall cost of an LED luminaire. 1 I recently spoke with engineering executives from two lighting companies about this and other technical challenges they face in the development of power electronics (PE) for LED lighting. Their descriptions of the factors that drive product development explain why PE engineering is now such an integral element of lighting product design.

Tackling Lamp Replacement

According to Guenther Derra, department head for Solid State Lighting at Philips Research, two streams of SSL product development influence the types of challenges faced by electronics designers. The first stream is the development of LED replacements for existing light bulbs.

“This [area of SSL] brings several technical challenges: the electronics have to be compatible with the given electrical infrastructure that has been designed and optimized for the now widely banned incandescent lamps,” says Derra. “The electronic circuit, together with the LEDs, the optics and the thermal interfaces have to fit in the same lamp form factor as the original incandescent lamps.”

Solid-state lighting (SSL) or LED lighting promises energy savings, longer lamp life, and other potential benefits in general lighting applications. Spurred on by steady improvements in high-brightness LEDs, government mandates, and growing interest in green technologies, LED lighting is seeing increasing adoption in commercial applications, and to a lesser extent in residential applications.

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