Trends in LED Design

By Tony Toniolo

I look back to February of 1989 when my career path brought me to the LED Industry. In retrospect, one may think I had a great vision of the future ? entering an industry that has grown in earnings and volume every year over the last 15 years. The truth is I am really stunned by LED technology.

Continually, while LEDs become brighter and cheaper; new colours and applications for LEDs are appearing in so many markets I truly believe LEDs will challenge every conventional light source during my lifetime.

LED manufacturers are driven by volume demand. Virtually any product that requires a status indicator can potentially use an LED. Look around. Besides the little LED at the end of your TV remote, LEDs are everywhere: automobile dashboards; appliances; computers; wireless products; medical devices; elevators ? even on kids? tennis shoes!

The success of LEDs lies in their longevity, energy efficiency, durability, low maintenance cost, and compact size. LEDs last up to 100,000 hours, compared to 1,000 hours for incandescent bulbs, which fail unexpectedly. Also, because there is no filament or gas heating prior to ignition, LEDs illuminate quicker than conventional lamps and use up to 90 per cent less energy.

The ever-increasing brightness of LEDs and availability of colours has enabled companies like DDP to look beyond the stigma of LEDs as ?idiot lights? to challenging applications where LEDs could be used as a light source to backlight lenses and legends. With the introduction of bright AlInGaP chip technology in the1990s, red and amber LEDs began replacing incandescent bulbs in new automotive taillight assemblies. And InGaN blue and green LED production ramped-up through the end of the 1990s due in large part to the demand for traffic signal green LEDs. With the full spectrum of bright colours available, new applications like illuminating message boards and channel lettering have created great demand within the industry. LEDs now dominate the exit sign market while we are building products with LED luminous intensity in the 10,000 millicandela range at 20mA.

As LED manufacturers continue to design products for status indication and backlighting, the new frontier driving LED technology is illumination. With the development of white LEDs we truly have a viable product to challenge all conventional illumination products. According to the U.S. Department of Energy, LEDs are expected to more than double the efficiency of general lighting systems, thereby reducing the nation?s electric bill by $98 billion over the next 20 years.

However, white LED colour variation presents a challenge for some applications. White light is created by merging all visible colours. This is accomplished by combining red, green, and blue LEDs, or a single blue LED with a phosphor coating. However, the human eye is very sensitive to slight differences in hue. Variations in the RGB color combining or variations in phosphor can be very noticeable depending on the application. The issue is less problematic on small projects requiring small numbers of LEDs which can be obtained from the same bin. In large-scale applications such as architectural lighting or signage, aesthetics are more critical.

Some LED manufacturers are beginning to offer white LED binned by colour temperature. Presently, most white LEDs are very high in the colour temperature range ? around 7000 Kelvin. For reference, sunlight is rated at 5600 Kelvin ? the higher the number the more ?blue?, the lower the number, the more ?yellow? the light will look. For applications such as architectural lighting, cinematography, and photography a more natural white light is essential.

We are already manufacturing products using high-current or high-flux LEDs, such as Lumileds Luxeon emitters which use multiple or larger dies and other methods to provide up to 500mW per LED. This new technology is already being used for spot illumination in products such as reading lights, flashlight engines, and task lighting. However, using high-flux LED technology can be tricky. Effective heat sinking is a key factor in ensuring stable LED performance over a long lifetime. Designing around the optimum LED junction temperature influences all aspects of LED design including longevity, colour, and intensity. As high-flux white LEDs evolve, demand for general illumination such as billboard and retail lighting will also drive demand and improve production yield.

The obvious objective for LED technology is to provide total solid-state ambient lighting. Presently many companies are working with organic light-emitting diodes (OLEDs) to produce flexible luminous sheets resembling illuminated wallpaper. OLEDs have the potential to integrate light sources with architectural materials from wall coverings to ceilings to furniture.

The future for LED technology is very bright. I?m truly excited about our LED design challenges utilizing such dynamic technology. If I had stayed in the automotive industry over the past 15 years and had seen the same technological advances as I have in the LED industry, we would be in hovercraft by now!

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