Light Matters

Designing illumination systems with high-brightness LEDs

Last month I highlighted two very small, very intense high-brightness LED families called the Oslon SSL and Oslon Square. If you recall, the Oslon SSL devices are unique because they're offered in both an 80° and 150° beam angle[1] version. The 80° pattern can be advantageous when a relatively narrow spot is required, or when creating narrower beams using a secondary lens placed over the LED package. The 150° version is tailored to "wide area lighting" as well as applications where reflectors are needed, or when it's important to create an evenly-lit appearance from an array of closely spaced emitters.

The Oslon SSL family is an example of the recent trend by LED manufacturers to optimize their portfolio for specific lighting end-products. It wasn't always like this; at one point there were noticeable gaps between the science of manufacturing high-brightness white LEDs and the art of creating compelling solid state lighting products with them.

Here's another new device that bridges this gap—the Duris S 8. First, some background. The aforementioned Oslons have a single LED die in the center of their package. Because light emitted from the small active area of the die approximates a point, smaller secondary lenses can be used, so the luminaire or light engine can be compact. As with all things there are tradeoffs, however. The forward voltage (V_f) of a single die is dependent on the semiconductor materials used; most white LEDs are actually blue LED die made from indium gallium nitride ("InGaN") and covered with phosphor. InGaN LEDs typically have a characteristic V_f in the neighborhood of 3.3 V. This means that although white LEDs are usually current-driven (constant-current), the output voltage of the power supply driving a single LED die will hover around that value.

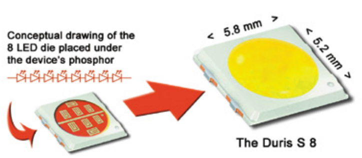
Where is the tradeoff? Well, if the input power to the light is 12 V, 24 V or higher, and the LED load is a single die, the efficiency of the system is negatively impacted. All high-to-low constant-current regulator topologies (e.g., "Buck" SMPS) are more efficient when their output voltages approach their input voltages. Thus dropping a 24 V input source down to a current-regulated output near 20 volts is more efficient than dropping it down to 3.3 volts. Some of the delta between input and output is wasted as heat.

A second tradeoff is the overall light output vs. luminaire "compactness". Using more LEDs will increase the volume of light, but the net active surface light emitting area will also be larger- and will require a considerably larger lens to create a focused beam.

One very familiar end-product where both of these tradeoffs come into play is track lighting. Many track lights are small, directional (focused) and bright. In older designs the light sources are typically halogen bulbs, operating off of 12 V, 24 V or AC-mains tracks. Halogens run extremely hot and produce undesirable UV. They're excellent candidates for technology upgrades; LEDs use about $^1/_8$th of the energy to produce the same amount of light.

These are some of the needs addressed by the Duris S 8. Although its package and light emitting surface area are small (5.8 x 5.2 mm^2 and 4.5 mm^2 respectively), it has a much higher V_f and light output.

Osram "Duris S 8" LED from Avnet



The high V_f is due to the fact that 8 individual LED die are wired in series inside the package; the resulting string's V_f is typically 26.5 V. Driven at 200 mA, the Duris S 8 produces about 500 lumens of warm white light. Its 3000 K color temperature corresponds nicely to the amber-tinted glow we expect from halogens. There are (or soon will be) other color temperatures and light output levels available. For applications requiring less light, or designs optimized for a 24 V supply, there's also a version of the Duris S 8 with just 5 LED die. Its V_f is typically 20 V. Both devices have a beam angle of 120°, about mid-way between the lens-oriented Oslon SSL 80° and the reflector-oriented 150° version.

For more information on the Duris S 8, contact your local Avnet representative, visit **www.em.avnet.com/DurisS8**, or send me a note. The complete part number for ordering the 8 LED version is "GW P9LRS1.EM", and for the 5 LED version it is "GW P9LMS1.EM". Note that some versions might not be available yet.

If you have questions on LEDs or LED-based systems, you're always welcome to send me a note at **LightSpeed@Avnet.com.** Regards, Cary

Cary Eskow is Global Director of the Solid State Lighting and Advanced LED business unit of Avnet Electronics Marketing. An ardent advocate of energy efficient LED-based illumination, he has worked closely with LED manufacturers, advanced analog IC and secondary optics vendors since his first patent using LEDs was issued two decades ago. Avnet works with customers through their national team of illumination-focused sales engineers who are experienced in thermal, drive stage and optics design. Prior to his LED lighting focus, Cary was Avnet's technical director and managed Avnet's North American FAE team.

To submit questions or ideas, e-mail Cary at LightSpeed@Avnet.com

[1]Beam angle relates to the outward spread of the light. In this case, it's the conical section through which 50% of the LED's light is projected. Thus an 80° beam angle implies that half of the total emitted light will be directed outward from the center axis of the device along an 80° cone.