

## **GOOD THERMAL MANAGEMENT IS KEY FOR A SUCCESSFUL LED LIGHTING DESIGN**

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Solid State Lighting (SSL) is one of the most promising markets in the electronic industry. The possibility for lower power consumption and consequently lower CO<sub>2</sub> emissions is one of the strong driving forces behind the high activity level we see in the SSL-field.

Especially with the improved high brightness (HB) and ultra high brightness (UHB) LEDs on the market, the lighting industry is seeing a lot of new design possibilities to design luminaries.

HB + UHB LEDs are opening new market areas where long product life and low power consumption are the key requirements. Typical applications are seen in architectural lighting, street lighting, automotive lighting but also more and more in retro-fit solutions.

With SSL design, the lifetime, light-output, efficiency and color stability are directly linked to the temperature seen in the LED-die. Despite popular believe, LEDs generate a lot of heat; roughly 80% of the electrical energy is converted into heat. A rule of thumb in the industry says that every 10°C temperature rise will half the life-time. Since the market requires at least a product life of 50,000 hours it is obvious that this cannot be achieved without taking care of the thermal aspects in our lighting design.

The presentation will provide you with some basics on Thermal Management. What are the methods to transport the heat? What is behind terms as "thermal conductivity", "thermal resistance" and "thermal impedance"? Some formulas will be explained which will help a design engineer to make thermal calculations and to get a good grip on the thermal design.

Within a luminaire the total thermal system comes from three areas: the LED component, the substrate with a proper thermal interface and finally the heat sink to ambient.

During the presentation the focus will be on the substrates and the thermal interface material between substrate and heatsink. The various substrates that are used in lighting designs will be discussed and we will look at the difference in thermal performance. The presentation includes various examples of thermal simulations and measurements to demonstrate the difference of the LED junction temperature when mounted on a FR4 substrate, versus substrates with higher thermal performances.

After the substrate has been chosen, the next step on the thermal stack-up is the thermal interface material. Since the thermal design is a series resistance of thermal resistances it is important not to create another thermal bottleneck in the chain. Several concepts and thermal interface materials will be discussed.

A good thermal management system is a must to meet the ever increasing expectations from the market. Without the right system in place, the SSL-device will not meet the required life-time. This presentation will help you to understand ways to get the heat out of your design and even potentially reduce the total cost of your design by optimum cooling solutions!