LED Thermal Management

Thermal Clad® Insulated Metal Substrates

With their high-intensity output, long life and small size, LEDs are fast becoming the light source of choice in many diverse applications. Proper thermal management helps optimize LED lifecycles.

LEDs Come of Age.

Light Emitting Diodes (LEDs) have been around for years, primarily concentrated in such markets as cell phones, PDAs and other consumer electronics. Since most of these products have relatively short lifecycles, protecting LEDs wasn't of primary concern because the product would fail or become obsolete long before the LED failed. Today, as technological advancements in LED design and processes are continually boosting light output to rival incandescent, florescent, and even halogen light sources, the need to protect the lamps against heat build-up is greater than ever before.

The Heat is ON.

As is true for most electronic components, heat is the greatest threat to an LED. While most people think of LEDs as running "cool," they actually create a significant amount of heat relative to their size. Not only can heat damage the electrical integrity of the LED, (eventually leading to lamp failure), it can also affect the light intensity and change the color of the light output. The key to maintaining consistent, high-intensity output over an extended period of time is state-of-the-art thermal management materials such as T-Clad™ Insulated Metal Substrates (IMS®).

How It Works.

In a typical LED configuration (see Figure 1), heat generated by the LED lamp is transferred to the base metal through the dielectric layer. However, most dielectrics selected for this purpose have little or no thermal conductivity to move heat away from the assembly and into the heat spreader (the base metal). Often referred to as enhanced dielectric, T-Clad minimizes thermal impedance and conducts heat more effectively and efficiently than standard printed circuit boards (see Figure 2).

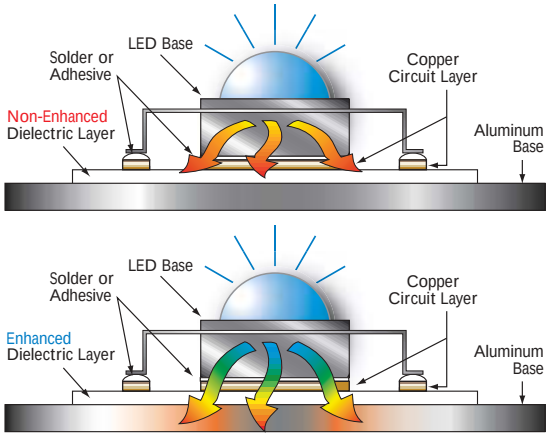

Figure 1

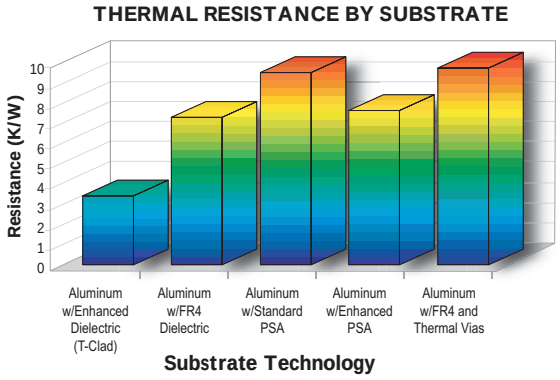

Figure 2

Case History.

Figure 3 shows the lifetime expectations for a sign illuminated with white InGaN/SiC LEDs at varying LED currents. In this application, the rated performance of the LED would only yield 4 years of life. By modifying the thermal management system and adjusting current to the LED, the customer obtained a slightly lower initial brightness but extended the useable lifetime to 11 years.

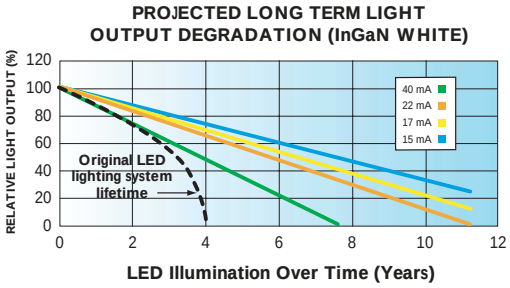

Figure 3

T-Clad Anatomy

T-Clad insulated metal substrates are comprised of a circuit layer, a thermally enhanced dielectric layer and a metal substrate (see Figure 4). The key to T-Clad's superior performance lies in its dielectric layer. This layer offers electrical isolation with high thermal conductivity and bonds the base metal and circuit foil together. Other manufacturers use reinforced fiberglass or pressure sensitive adhesive (PSA) as a dielectric layer, but none of them provide the high thermal conductivity and resulting thermal performance required to help assure the lowest possible operating temperatures and brightest light output for high-intensity LEDs.

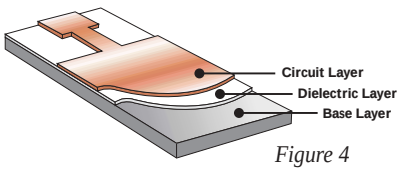

Figure 4

Figure 2 courtesy of OSRAM Application Note, August 17, 2002. Figure 3 courtesy of Permlight Products Enlighten newsletter, October 2002.

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