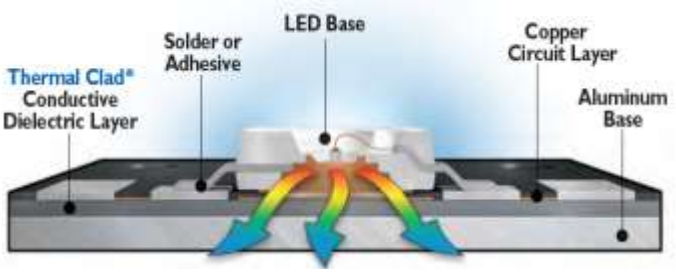
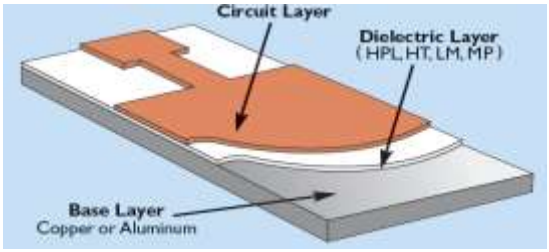
LED (Light Emitting Diode) lighting material selection for use in the EMS Industry

Surface Mount Technology in Appleton WI realizes continued growth in all sectors of the LED lighting enterprise along with bright future growth opportunities.

Today, as technology advancements are made in LED designs lumen outputs are vastly increased while energy costs are reduced verses dated technologies of incandescent, fluorescents, and even halogen light deices. Thus this creates the need to protect the LED's against heat build-up in high power fixtures.. Three and five-watt LED's are now quite common and market experts are predicting a 10-watt LED in a few years. Power LEDs (High Power/High White LED's) greater than one-watt are nearly all surface mounted devices. This is because the axial leads to the die in a leaded package do not conduct enough heat away from the LED. Chip-on-board (COB), ceramic surmounts and other thermally efficient packages are emerging as the standard thermal management packaging solution for Lower Power LEDs.



The LED's color, or wavelength, does change with temperature. As the die temperature increases, the wavelength of the color increases. This is particularly important with white light. The human eye can differentiate only small changes in white light color. When Power LEDs are populated in an array (arranged in a particular way), consistent thermal resistance from one die to the next assures consistent color. Because of the comparatively low thermal resistance materials like aluminum and copper offers versus FR-4, die temperature is less affected by slight variances in the junction-to-case thermal resistance that occurs with eutectic or epoxy-die mounting techniques. It is also possible to pack the die more closely in an assembly that utilizes good thermal management techniques, thereby reducing the effects of temperature. Generally, a 30-50 percent drop in light output for a constant-forward current indicates end-of-life for Power LEDs. Power LED lifetimes have been extrapolated to over 50,000 hours if the thermal properties are designed for properly.



Optimal thermal management allows more forward current applied to the LED, which means increased light and potentially a reduction of LEDs required for the desired light specification. Supporting a cooler assembly with equivalent power equates to more light per die, and ultimately less dollars per lumen.

Metal core PCB and standard FR-4 are commonly used circuit board materials in conjunction with Low and Mid Power LEDs. The key to superior thermal performance lies in its dielectric layer usually a thin, thermally conductive layer bonded to an aluminum or copper substrate for heat dissipation (see illustration below). This layer offers electrical isolation with high thermal conductivity and bonds the base metal and circuit foil together. Some manufacturers use standard prepreg (a fibrous preimpregnated material with resin) as the dielectric layer, but prepreg doesn't 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.

There are several options available for thermal management of Power LEDs. The most critical thermal path in the stack is the one with the highest thermal resistance. Good practice suggests that you reduce the thermal resistance of that layer with Thermal Clad dielectric instead of FR-4.