

UNDERSTANDING LED's Vs "POWER" LED's

These LEDs are sometimes called "power" LEDs or "high-flux LEDs". In the past few years, LED manufacturing has come a long way, and has been primarily driven by the needs of LCD backlighting and digital signage markets. As a general statement, you can take *any* LED and apply high current and it will be VERY bright for a VERY short period of time. The problem is: a) the heat generated at the diode's junction and b) the dissipation of this heat. So an LED can be made brighter if you can solve these two things, plus package the device so that the light is emitted in a consistent pattern and color.

The LEDs on the 6-LED G4s are "surface mount devices" (SMD's) and get their brightness mainly from three factors:

- 1) The design, materials, and manufacturing improvements in the "epigrowth process", which is the laydown of the constituent materials of the semiconductor that makes up the diode's P and N junction (which gives off the photons). In the case of our bulbs, these materials are primarily InGaN (Indium, Gallium and Nitrogen) and others like phosphorus to get the warm white color. These improvements in the quality and consistency of the materials allow a higher forward currents to be applied to the junction (~350mA for the LED's used here). And more current translates into more brightness.
- 2) Lower Thermal Resistance is another result of improved design and manufacturing. In the case of our bulbs, this allows there to be approximately 1/2 of the temperature increase at the junction compared to that of traditional LEDs (at same current).
- 3) Axially leaded LED's (like in the 21 LEDs) while also benefiting from recent technology improvements, have to dissipate the heat created at the junction through the two leads down to the thru-holes to the substrate (PCB). In the case of the SMD, it is designed to transfer the heat much better via its surface mount package directly to the PCB, with more contact area for heat transfer. This improved heat transfer also allows higher current and higher brightness.

In the G4 package it is a balancing act between 5 factors:

1. LED and Cluster Package Size (to fit within the G4's envelope)
2. Heat dissipation (= bulb life)
3. Current Draw (energy consumption)
4. Brightness
5. Cost

For instance, we know we can make a brighter cluster. Our SMTs are 1W, and there are 3W (and higher) high-flux LEDs available. But if we go to the 3W, we need a bigger footprint (the 3W's are bigger), we'll also need a better heat-transfer strategy (heat-sinks and the like), we'll draw more than double the current, and it will be more expensive. For sailboats with existing fixtures, the 6-LED cluster is a good compromise, but it is certainly more "hairy edge" from a heat dissipation standpoint than the 21-LED cluster, which solves the problem with lower-current, lower-cost LEDs, but has many more of them. Another approach is the Sensibulb with fewer, brighter LEDs, but it has a bigger package size, draws more current, and is more expensive.