INNOVATIONS IN OPTICS

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CONSTANT CURRENT OPERATION

The current/voltage characteristic of an LED is similar to other diodes, in that the current is dependent exponentially on the voltage. A small change in voltage can cause a large change in current. If the maximum voltage rating is exceeded by a small amount, the current rating may be exceeded by a large amount, potentially damaging or destroying the LED. The typical solution is to use constant-current power supplies for operating LumiBright™ Light Engines. The two primary reasons to drive them with constant current:

1. To avoid violating the Absolute Maximum Current Rating and compromising the reliability.
2. To obtain predictable and matched output from each LED.

LED DIE ARRAYS AND OPEN CIRCUIT VOLTAGE

All LumiBright products feature chip-on-board LED die on a metallic circuit board. Die arrays provide greater optical power output and multi-color possibilities. LumiBright products with single color die arrays are connected in parallel and large arrays can be operated at drive currents up to 30A. Drive circuits must prevent exceeding the maximum recommended open circuit voltage for the LED die. In a multi-color die array, the total die for any single bin color are connected in parallel. Since the forward voltage varies with different LED die types, the maximum open circuit voltage will be different for each color's drive "channel". Forward voltage can average from 1.2V for NIR die up to 4.0V for UVA die. The maximum recommended open circuit voltage will also depend on the maximum drive current for any LumiBright product.

PULSING

LumiBright Products can be easily pulsed. LED response times are typically in the range 10 ns to 100 ns. There are two main reasons for the use of pulsed operation with LED illuminators:

1. The first is to freeze action to acquire an image with a shutterless camera or detector, i.e. provide illumination that is synchronized with the imaging.
2. The second reason is to increase the effective brightness of the illuminator during the pulse by using a higher pulse current than the CW rating, since the luminance is proportional to current.

LIFETIME

The limitations on LED lifetime are mostly thermally-induced. Every LumiBright circuit board has a built-in thermistor for temperature monitoring. Lifetime of LumiBright Products operated continuously would be compromised if the temperature of the circuit board exceeds 60°C.

Pulsed LED illuminators can achieve lifetime over 50,000 hours for monochromatic chips. If low duty cycles are combined with short on-times, so that the junction temperature of the LED is kept close to ambient, then effective operating lifetimes can be extended.

THERMAL MANAGEMENT

LumiBright Products use metal core boards for high thermal conductivity that allow heat to dissipate in all directions. Reduced overall thermal resistance results in increased LED performance. When thermal energy generated exceeds the thermal energy dissipated, an additional means of cooling may be required to maintain LED performance. An external heat sink or heat pipe is required to dissipate the heat generated at full drive power.

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Adding the feature of forced air convection across the heat sink or heat pipe fins removes heat faster and more efficiently. LumiBright Products circuit board features an attached thermal pad for heat sink contact, no thermal grease is needed. Every LumiBright circuit board has a built-in thermistor for temperature monitoring. Lifetime of LumiBright Products would be compromised if the temperature of the circuit board exceeds 60°C.

ADDITIONAL RESOURCES

The connector pin assignments for every LumiBright product are located on its *Installation Control Drawing (ICD)*. ICDs, solid models, a die wavelength chart, and the *Thermistor Equation* for converting impedance to temperature are available as Downloadable Resources at www.innovationsinoptics.com/downloadable/index.html.