

## BL-4000SERIES

## RGB+ LED Light Engine

### Lamina Light Engines

As the market leader in the development and manufacture of super-bright LED arrays, Lamina brings solid state lighting to applications which until now were only possible with traditional lighting sources.

Lamina's LED arrays are manufactured by combining high brightness LEDs from industry-leading LED manufacturers with Lamina's proprietary packaging technology, multilayer Low Temperature Co-Fired Ceramic on Metal (LTCC-M). LTCC-M is a breakthrough in thermal performance for LED packaging technology, a key factor in determining LED life and reliability. Unmatched thermal performance coupled with package interconnectivity allow Lamina to densely cluster multiple LEDs to achieve exceptionally high luminous intensity in very small footprints. Lamina's arrays are available in white, RGB and monochrome, from 1W to 100W, and also in custom packages up to 1000W.

Lamina LED Light sources provide:

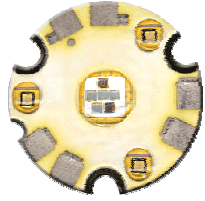
- **HIGH LUMINOUS FLUX IN SMALL FOOTPRINT**
- **SUPERIOR THERMAL PERFORMANCE FOR IMPROVED RELIABILITY**
- **LONG LIFE AND HIGH LUMEN MAINTENANCE**
- **SUSTAINABLE DESIGN – RoHS COMPLIANT**
- **CUSTOM SIZES, SHAPES AND CONFIGURATIONS AVAILABLE**

### BL-4000 RGB+

Lamina's newest LED light source delivers 120 lumens of blended RGB light. Lamina's BL-4000 RGB LED arrays have independent color control for dynamic or preset display of colors. Through additive color mixing there is complete control of up to 16 million colors and various white color temperatures which can be produced.

Lamina BL-4000 LED arrays are configured with a single cavity populated with multiple LEDs. The RGB+ light engine has red, green and blue LED die arranged for optimal color mixing within each light engine, a unique feature made possible with Lamina's packaging technology. The new design incorporates many new features, including:

- Round footprint for design flexibility
- Designed for popular drive currents – 350 mA
- Three channel control with independent input/output
- Compatible with many popular LED optics
- Integrated ESD protection – 2,000V HBM
- Isolated metal base - makes wiring in series or parallel possible on a common heat sink
- Large solder pads and Lamina EZConnect PCB adapter available
- Lamina heat sinks available



### TYPICAL APPLICATIONS

#### ARCHITECTURAL LIGHTING

- DECORATIVE AND ACCENT
- COVE AND UNDER-SHELF
- GARDEN AND PATHWAY
- STEP LIGHTS

#### ARCHITAINMENT

#### LCD BACKLIGHTING

#### SIGNAGE & CHANNEL LETTERS

#### SIGNALS

- AIRFIELD TAXIWAY
- TRAFFIC
- SECURITY
- BEACONS
- RAIL

#### MACHINE VISION

#### MEDICAL

## Technical Data

P/N BL-43F0-0305		Symbol	Min	Typical	Max	Unit
Wavelength <sup>1</sup>	R:	$\lambda$	619	624	629	nm
	G:	$\lambda$	525	530	535	nm
	B:	$\lambda$	460	465	470	nm
Voltage <sup>1</sup>	R:	$V_F$	-	4.5	5.1	V
	G:	$V_F$	6.3	6.7	9.0	V
	B:	$V_F$	6.5	7.6	9.0	V
Test Current	R:	$I_F$	-	0.35	0.45	A
	G:	$I_F$	-	0.35	0.40	A
	B:	$I_F$	-	0.35	0.40	A
Power Consumption	R:	P	-	1.6	-	W
	G:	P	-	2.4	-	W
	B:	P	-	2.7	-	W
Luminous Flux <sup>1</sup>	R:	$\Phi_F$	24	42	-	lm
	G:	$\Phi_F$	38	63	-	lm
	B:	$\Phi_F$	9	15	-	lm
Thermal Resistance <sup>2</sup>	R:	$T_R$	-	2.5	3.1	°C/W
	G:	$T_R$	-	2.5	3.1	°C/W
	B:	$T_R$	-	2.5	3.1	°C/W
Operating Temperature <sup>3</sup>	:	$T_J$	-40		115	°C
Storage Temperature	:		-40		100	°C
Assembly Temperature	:				250°C, < 5 sec.	°C
ESD Sensitivity	:	HBM	2,000			V

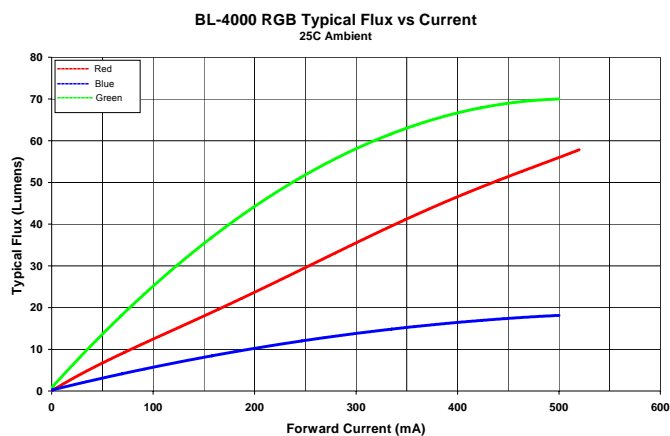
Note 1. Optical and electrical specifications are given for the specified drive current at a 25° C junction temperature.

Note 2. Values for operating all colors at rated current.

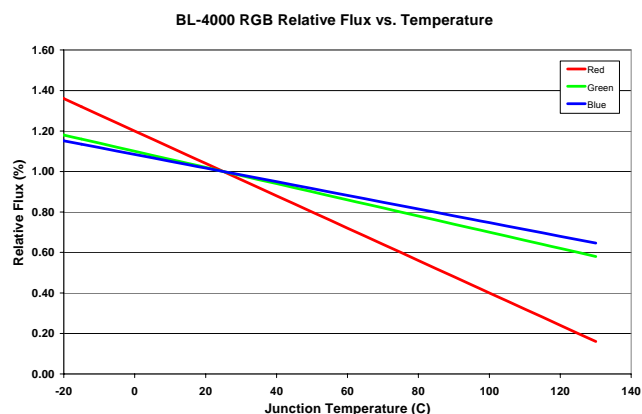
Note 3. Operating temperature for LED die junction. Lower temperatures improve lumen maintenance.

## Light Output Characteristics

### Luminous Flux vs. Current



### Relative Luminous Flux vs. Temperature



## Luminous Flux vs. Current

When operating at drive currents higher than test currents indicated be sure to stay below maximum recommended junction temperature. Higher drive currents will increase luminous flux but also increase thermal load. Without proper heat sinking lower efficacy (lumens per watt) and lower lumen maintenance may result. For operating below test currents indicated pulse width modulation is recommended for maximum consistency and stability of light properties.

*To see how you can realize all these design benefits, to request a sample, or to speak with an engineer about your design, contact Lamina at 800.808.5822 or 609.265.1401 or visit [www.laminaceramics.com](http://www.laminaceramics.com).*

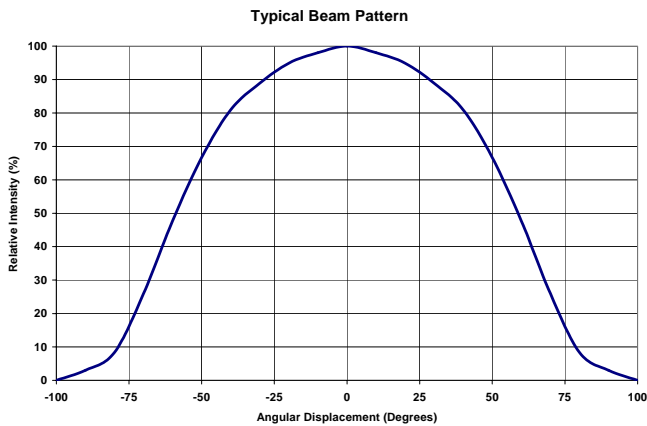
## Luminous Flux vs. Junction Temperature

Light output from LED die will decrease with increasing junction temperature. This effect is particularly acute for die in the 580 to 750 nm range. As a result we recommend that the LED array heat sink design be optimized to maintain the die junction temperature as low as possible.

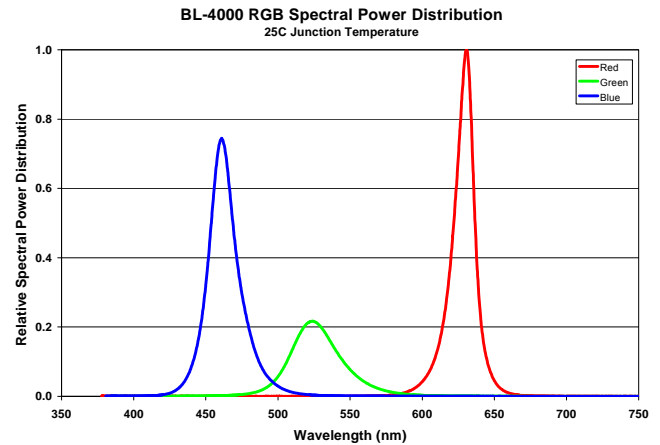
## Typical Beam Pattern

Lamina's BL-4000 LED arrays project a 125° ( $2\theta_{1/2}$ , 50% of peak value) Lambertian radiation pattern. Narrower beam distributions can be produced by use of selected popular LED optics. Please contact Lamina Application Engineering for support with your optical needs.

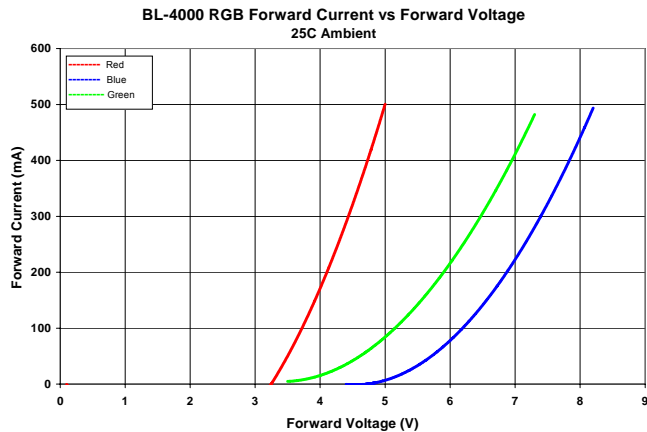
### Typical Beam Pattern



### Spectral Power Distribution



## Forward Current vs. Forward Voltage



## Electrical Connections

Lamina's BL-4000 Series is configured with solder pads compatible with Sn63 or Sn62 solder. As with many electrical devices, non-acid RMA type solder flux should be used to prepare the solder pads before application of solder. If wire attachment is performed with a soldering iron, care must be taken to minimize heat transfer to the die and minimize leaching of the solderable pads. See Lamina's Attachment application note for more information.

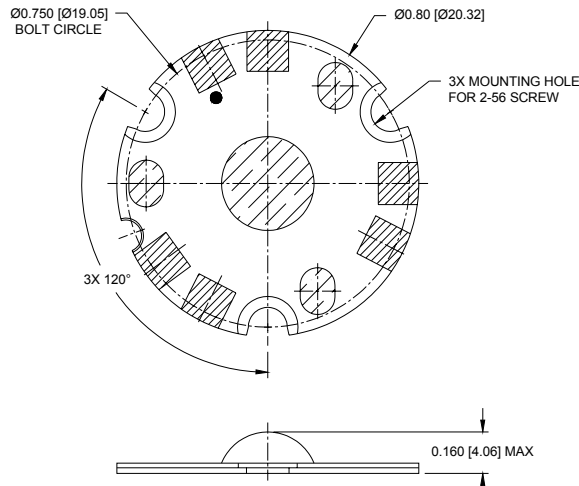
Lamina has developed EZConnect PCB adapters with connectors for BL-4000 products for ease of assembly.

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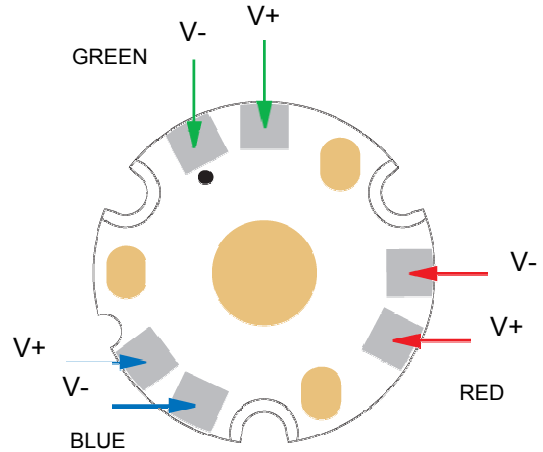
## Assembly Recommendations

Lamina's BL Series Light Engines are designed for attachment to a heat sink with conductive epoxy, or screw down for flange mount devices with thermal grease in the joint. For attachment using screws, a 2-56 UNC round head or metric equivalent M2 0.4 Cheese Head screw, 18-8 SS is recommended. Maximum torque is 4 inch pounds (45 Newton-centimeter). Required flatness of surface light engine is mounted to is 0.001 inch/inch.

### Mechanical Specifications



### Electrical Connections



## Heat Sink Recommendations

Lamina LED arrays provide efficient transfer of heat from the individual LED die to a customer supplied heat sink. Lamina's BL-4000 arrays must be operated at or below 115°C die junction temperature. A heat sink must be attached to the array with sufficient cooling capacity to keep the die junction below 115°C. The temperature rise from the array base to the die junction may be determined by calculating the product of the maximum package thermal resistance and the desired operating power level.

$$\text{Junction Temperature Rise (Tj (rise))} = \text{Operating Power (P)} \times (\text{Lamina Array Thermal Resistance})$$

The appropriate heat sink may then be approximated\* by:

$$\text{Heat Sink Thermal Resistance (°C/W)} = (115\text{ °C} - \text{Tj (rise)} - \text{Maximum Ambient Temperature})/P$$

\*Approximation assumes light engines are screwed down and thermal grease is used as thermal interface material.

Lamina has developed a selection of radial heat sinks for rapid prototyping of designs with Lamina's LED Light Engines. Lamina's heat sinks are available through selected distributors. More information on Lamina's heat sinks and distributors is available on our website.

## Handling Precaution

Contact with the silicone based encapsulant on the surface of the light engine must be avoided to prevent damage. Do not apply pressure to the silicone based encapsulant or allow it to come into contact with sharp objects. Lamina LED arrays must be handled from the sides.

Lamina Ceramics

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Specifications subject to change without notice.

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