

# power light source

# Luxeon III Star

## Introduction

Luxeon® III is a revolutionary, energy efficient and ultra compact new light source, combining the lifetime and reliability advantages of Light Emitting Diodes with the brightness of conventional lighting.

Luxeon III is rated for up to 1400mA operation, delivering increased lumens per package.

Luxeon Power Light Sources give you total design freedom and unmatched brightness, creating a new world of light.

For high volume applications, custom Luxeon power light source designs are available upon request, to meet your specific needs.



## Features

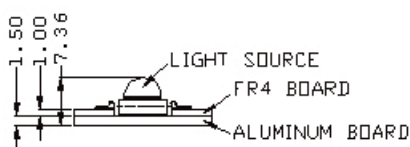
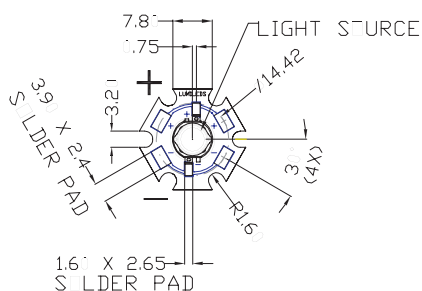
- ♦ Highest flux per LED family in the world
- ♦ Very long operating life (up to 100k hours)
- ♦ Available in 5500K white, green, blue, royal blue, cyan
- ♦ Lambertian and side emitting radiation patterns
- ♦ More energy efficient than incandescent and most halogen lamps
- ♦ Low voltage DC operated
- ♦ Cool beam, safe to the touch
- ♦ Instant light (less than 100 ns)
- ♦ Fully dimmable
- ♦ No UV
- ♦ Superior ESD protection

## Typical Applications

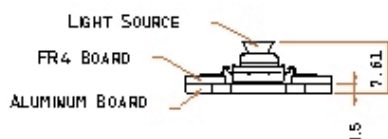
- ♦ Reading lights (car, bus, aircraft)
- ♦ Portable (flashlight, bicycle)
- ♦ Mini-accent/Uplighters/Downlighters/Orientation
- ♦ Fiber optic alternative/Decorative/Entertainment
- ♦ Bollards/Security/Garden
- ♦ Cove/Undershelf/Task
- ♦ Automotive rear combination lamps
- ♦ Traffic signaling/Beacons/ Rail crossing and Wayside
- ♦ Indoor/Outdoor Commercial and Residential Architectural
- ♦ Edge-lit signs (Exit, point of sale)
- ♦ LCD Backlights/Light Guides

## Mechanical Dimensions

### Luxeon III Star



#### Side Emitting



#### Notes:

1. Slots in aluminum-core PCB for M3 or #4 mounting screw.
2. Electrical interconnection pads labeled on the aluminum-core PCB with "+" and "-" to denote positive and negative, respectively.  
All positive pads are interconnected, as are all negative pads, allowing for flexibility in array interconnection.
3. Electrical insulation between neighboring Stars is required —aluminum board is not electrically neutral.
4. Drawings not to scale.
5. All dimensions are in millimeters.

## Flux Characteristics at 700mA, Junction Temperature, $T_J = 25^\circ\text{C}$

Table 1.

| Color                     | Luxeon Emitter | Minimum Luminous Flux (lm) or Radiometric Power (mW) $\Phi_V$ [1,2] | Typical Luminous Flux (lm) or Radiometric Power (mW) $\Phi_V$ [2] | Radiation Pattern |
|---------------------------|----------------|---------------------------------------------------------------------|-------------------------------------------------------------------|-------------------|
| White                     | LXHL-LW3C      | 60.0                                                                | 65                                                                | Lambertian        |
| Green                     | LXHL-LM3C      | 51.7                                                                | 64                                                                |                   |
| Cyan                      | LXHL-LE3C      | 51.7                                                                | 64                                                                |                   |
| Blue <sup>[3]</sup>       | LXHL-LB3C      | 13.9                                                                | 23                                                                |                   |
| Royal Blue <sup>[4]</sup> | LXHL-LR3C      | 275 mW                                                              | 340 mW                                                            | Side Emitting     |
| White                     | LXHL-FW3C      | 51.7                                                                | 58                                                                |                   |
| Green                     | LXHL-FM3C      | 51.7                                                                | 58                                                                |                   |
| Blue <sup>[3]</sup>       | LXHL-FB3C      | 13.9                                                                | 21                                                                |                   |

## Flux Characteristics at 1000mA, Junction Temperature, $T_J = 25^\circ\text{C}$

Table 2.

| Color                     | Luxeon Emitter | Typical Luminous Flux (lm) or Radiometric Power (mW) |         | Radiation Pattern |
|---------------------------|----------------|------------------------------------------------------|---------|-------------------|
|                           |                | $\Phi_V^{[1,2]}$                                     | 1000 mA |                   |
| White                     | LXHL-LW3C      | 80                                                   |         | Lambertian        |
| Green                     | LXHL-LM3C      | 80                                                   |         |                   |
| Cyan                      | LXHL-LE3C      | 80                                                   |         |                   |
| Blue <sup>[3]</sup>       | LXHL-LB3C      | 30                                                   |         |                   |
| Royal Blue <sup>[4]</sup> | LXHL-LR3C      | 450 mW                                               |         |                   |
| White                     | LXHL-FW3C      | 70                                                   |         | Side Emitting     |
| Green                     | LXHL-FM3C      | 70                                                   |         |                   |
| Blue <sup>[3]</sup>       | LXHL-FB3C      | 27                                                   |         |                   |

Notes for Tables 1 & 2:

1. Minimum luminous flux or radiometric power performance guaranteed within published operating conditions. Lumileds maintains a tolerance of  $\pm 10\%$  on flux and power measurements.
2. Luxeon types with even higher luminous flux levels will become available in the future. Please consult your Lumileds Authorized Distributor or Lumileds sales representative for more information.
3. Typical flux value for 470 nm devices. Due to the CIE eye response curve in the short blue wavelength range, the minimum luminous flux will vary over the Lumileds blue color range. Luminous flux will vary from a typical of 17 lm for the 460-465nm bin to a typical of 30 lm for the 475-480 nm bin due to this effect. Although the luminous power efficiency is lower in the short blue wavelength range, radiometric power efficiency increases as wavelength decreases. For more information, consult the Luxeon Design Guide, available upon request.
4. Royal Blue product is binned by radiometric power and peak wavelength rather than photometric lumens and dominant wavelength.

## Flux Characteristics at 1400mA, Junction Temperature, $T_J = 25^\circ\text{C}$

Table 3.

| Color      | Luxeon Emitter | Minimum Luminous Flux (lm) | Typical Luminous Flux (lm) | Radiation Pattern |
|------------|----------------|----------------------------|----------------------------|-------------------|
|            |                | $\Phi_V^{[1,2]}$           | $\Phi_V^{[2]}$             |                   |
| Red        | LXHL-LD3C      | 90                         | 140                        | Lambertian        |
| Red-Orange | LXHL-LH3C      | 120                        | 190                        |                   |
| Amber      | LXHL-LL3C      | 70                         | 110                        |                   |
| Red        | LXHL-FD3C      | 90                         | 125                        | Side Emitting     |
| Red-Orange | LXHL-FH3C      | 120                        | 170                        |                   |
| Amber      | LXHL-FL3C      | 70                         | 100                        |                   |

Notes for Table 3:

1. Minimum luminous flux performance guaranteed within published operating conditions. Lumileds maintains a tolerance of  $\pm 10\%$  on flux measurements.
2. Luxeon types with even higher luminous flux levels will become available in the future. Please consult your Lumileds Authorized Distributor or Lumileds sales representative for more information.

## Optical Characteristics at 700mA, Junction Temperature, $T_J = 25^\circ\text{C}$

Table 4.

| Radiation Pattern | Color                     | Dominant Wavelength <sup>[1]</sup><br>$\lambda_D$ ,<br>Peak Wavelength <sup>[2]</sup> $\lambda_P$ ,<br>or Color Temperature <sup>[3]</sup><br>CCT |       |        | Spectral<br>Half-width <sup>[4]</sup><br>(nm)<br>$\Delta\lambda_{1/2}$ | Temperature<br>Coefficient of<br>Dominant<br>Wavelength<br>(nm/ $^\circ\text{C}$ )<br>$\Delta\lambda_D / \Delta T_J$ | Total<br>Included<br>Angle <sup>[5]</sup><br>(degrees)<br>$\theta_{0.90V}$ | Viewing<br>Angle <sup>[6]</sup><br>(degrees)<br>$2\theta_{1/2}$ |
|-------------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------|
|                   |                           | Min.                                                                                                                                              | Typ.  | Max.   |                                                                        |                                                                                                                      |                                                                            |                                                                 |
| Lambertian        | White                     | 4500K                                                                                                                                             | 5500K | 10000K | —                                                                      | —                                                                                                                    |                                                                            |                                                                 |
|                   | Green                     | 520nm                                                                                                                                             | 530nm | 550nm  | 35                                                                     | 0.04                                                                                                                 | 160                                                                        | 140                                                             |
|                   | Cyan                      | 490nm                                                                                                                                             | 505nm | 520nm  | 30                                                                     | 0.04                                                                                                                 | 160                                                                        | 140                                                             |
|                   | Blue                      | 460nm                                                                                                                                             | 470nm | 490nm  | 25                                                                     | 0.04                                                                                                                 | 160                                                                        | 140                                                             |
|                   | Royal Blue <sup>[2]</sup> | 440nm                                                                                                                                             | 455nm | 460nm  | 20                                                                     | 0.04                                                                                                                 | 160                                                                        | 140                                                             |

## Optical Characteristics at 700mA, Junction Temperature, $T_J = 25^\circ\text{C}$ Continued

Table 5.

| Radiation Pattern | Color | Dominant Wavelength <sup>[1]</sup><br>$\lambda_D$ ,<br>or Color Temperature <sup>[3]</sup><br>CCT |       |        | Spectral<br>Half-width <sup>[4]</sup><br>(nm)<br>Cum $\Phi_{45^\circ}$ | Temperature<br>Coefficient of<br>Dominant<br>Wavelength<br>(nm/ $^\circ\text{C}$ )<br>$\Delta\lambda_D / \Delta T_J$ | Typical<br>Total Flux<br>Percent<br>within<br>first $45^\circ$ <sup>[7]</sup><br>Cum $\Phi_{45^\circ}$ | Typical<br>Angle<br>of Peak<br>Intensity <sup>[8]</sup><br>$\theta_{\text{Peak}}$ |
|-------------------|-------|---------------------------------------------------------------------------------------------------|-------|--------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
|                   |       | Min.                                                                                              | Typ.  | Max.   |                                                                        |                                                                                                                      |                                                                                                        |                                                                                   |
| Side Emitting     | White | 4500K                                                                                             | 5500K | 10000K | —                                                                      | —                                                                                                                    | <15%                                                                                                   | $75^\circ - 85^\circ$                                                             |
|                   | Green | 520nm                                                                                             | 530nm | 550nm  | 35                                                                     | 0.04                                                                                                                 | <15%                                                                                                   | $75^\circ - 85^\circ$                                                             |
|                   | Blue  | 460nm                                                                                             | 470nm | 490nm  | 20                                                                     | 0.04                                                                                                                 | <15%                                                                                                   | $75^\circ - 85^\circ$                                                             |

Notes: (for Tables 4 & 5)

1. Dominant wavelength is derived from the CIE 1931 Chromaticity diagram and represents the perceived color. Lumileds maintains a tolerance of  $\pm 0.5\text{nm}$  for dominant wavelength measurements.
2. Royal Blue product is binned by radiometric power and peak wavelength rather than photometric lumens and dominant wavelength. Lumileds maintains a tolerance of  $\pm 2\text{nm}$  for peak wavelength measurements.
3. CRI (Color Rendering Index) for White product types is 70. CRI for Warm White product type is 90 with typical Rg value of 70. CCT  $\pm 5\%$  tester tolerance.
4. Spectral width at  $1/2$  of the peak intensity.
5. Total angle at which 90% of total luminous flux is captured.
6.  $\theta_{1/2}$  is the off axis angle from lamp centerline where the luminous intensity is  $1/2$  of the peak value.
7. Cumulative flux percent within  $\pm 45^\circ$  from optical axis.
8. Off axis angle from lamp centerline where the luminous intensity reaches the peak value.
9. All white, green, cyan, blue and royal blue products built with Indium Gallium Nitride (InGaN). All red, red-orange and amber products built with Aluminum Indium Gallium Phosphide (AlInGaP).
10. Blue and Royal Blue power light sources represented here are IEC825 Class 2 for eye safety.

## Optical Characteristics at 1400mA, Junction Temperature, $T_J = 25^\circ\text{C}$

Table 6.

| Radiation Pattern | Color      | Dominant Wavelength <sup>[1]</sup> |                  |         | Spectral Half-width <sup>[2]</sup><br>(nm)<br>$\Delta\lambda_{1/2}$ | Temperature Coefficient of Dominant Wavelength<br>(nm/ $^\circ\text{C}$ )<br>$\Delta\lambda_D / \Delta T_J$ | Total Included Angle <sup>[3]</sup><br>(degrees)<br>$\theta_{0.90V}$ | Viewing Angle <sup>[4]</sup><br>(degrees)<br>$2\theta_{1/2}$ |
|-------------------|------------|------------------------------------|------------------|---------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------|
|                   |            | Min.                               | $\lambda_D$ Typ. | Max.    |                                                                     |                                                                                                             |                                                                      |                                                              |
| Lambertian        | Red        | 620.5nm                            | 627nm            | 645nm   | 20                                                                  | 0.05                                                                                                        | 170                                                                  | 130                                                          |
|                   | Red-Orange | 613.5nm                            | 617nm            | 620.5nm | 18                                                                  | 0.06                                                                                                        | 170                                                                  | 130                                                          |
|                   | Amber      | 584.5nm                            | 590nm            | 597nm   | 17                                                                  | 0.09                                                                                                        | 170                                                                  | 130                                                          |

## Optical Characteristics at 1400mA, Junction Temperature, $T_J = 25^\circ\text{C}$ , Continued

Table 7.

| Radiation Pattern | Color      | Dominant Wavelength <sup>[1]</sup> |                  |         | Spectral Half-width <sup>[2]</sup><br>(nm)<br>$\Delta\lambda_{1/2}$ | Temperature Coefficient of Dominant Wavelength<br>(nm/ $^\circ\text{C}$ )<br>$\Delta\lambda_D / \Delta T_J$ | Typical Total Flux Percent within first 45° <sup>[5]</sup><br>Cum $\Phi_{45^\circ}$ | Typical Angle of Peak Intensity <sup>[6]</sup><br>$\theta_{Peak}$ |
|-------------------|------------|------------------------------------|------------------|---------|---------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------|
|                   |            | Min.                               | $\lambda_D$ Typ. | Max.    |                                                                     |                                                                                                             |                                                                                     |                                                                   |
| Side Emitting     | Red        | 620.5nm                            | 627nm            | 645nm   | 20                                                                  | 0.05                                                                                                        | <30%                                                                                | 75° - 85°                                                         |
|                   | Red-Orange | 613.5nm                            | 617nm            | 620.5nm | 18                                                                  | 0.06                                                                                                        | <30%                                                                                | 75° - 85°                                                         |
|                   | Amber      | 584.5nm                            | 590nm            | 597nm   | 17                                                                  | 0.09                                                                                                        | <30%                                                                                | 75° - 85°                                                         |

Notes: (for Tables 6 & 7)

1. Dominant wavelength is derived from the CIE 1931 Chromaticity diagram and represents the perceived color. Lumileds maintains a tolerance of  $\pm 0.5\text{nm}$  for dominant wavelength measurements.
2. Spectral width at  $1/2$  of the peak intensity.
3. Total angle at which 90% of total luminous flux is captured.
4.  $\theta_{1/2}$  is the off axis angle from lamp centerline where the luminous intensity is  $1/2$  of the peak value.
5. Cumulative flux percent within  $\pm 45^\circ$  from optical axis.
6. Off axis angle from lamp centerline where the luminous intensity reaches the peak value.
7. All red, red-orange and amber products built with Aluminum Indium Gallium Phosphide (AlInGaP).

## Electrical Characteristics at 700mA, Junction Temperature, $T_J = 25^\circ\text{C}$

Table 8.

| Color      | Forward Voltage $V_F$ <sup>[1]</sup> |      |      | Dynamic Resistance <sup>[2]</sup><br>( $\Omega$ ) $R_D$ | Temperature Coefficient of Forward Voltage <sup>[3]</sup><br>(mV/ $^\circ\text{C}$ )<br>$\Delta V_F / \Delta T_J$ | Thermal Resistance, Junction to Board<br>( $^\circ\text{C/W}$ ) $R_{\theta_{J-B}}$ |
|------------|--------------------------------------|------|------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|            | Min.                                 | Typ. | Max. |                                                         |                                                                                                                   |                                                                                    |
| White      | 3.03                                 | 3.70 | 4.47 | 0.8                                                     | -2.0                                                                                                              | 17                                                                                 |
| Green      | 3.03                                 | 3.70 | 4.47 | 0.8                                                     | -2.0                                                                                                              | 17                                                                                 |
| Cyan       | 3.03                                 | 3.70 | 4.47 | 0.8                                                     | -2.0                                                                                                              | 17                                                                                 |
| Blue       | 3.03                                 | 3.70 | 4.47 | 0.8                                                     | -2.0                                                                                                              | 17                                                                                 |
| Royal Blue | 3.03                                 | 3.70 | 4.47 | 0.8                                                     | -2.0                                                                                                              | 17                                                                                 |

Notes for Table 8:

1. Lumileds maintains a tolerance of  $\pm 0.06\text{V}$  on forward voltage measurements.
2. Dynamic resistance is the inverse of the slope in linear forward voltage model for LEDs. See Figures 3a and 3b.
3. Measured between  $25^\circ\text{C} \leq T_J \leq 110^\circ\text{C}$  at  $I_F = 700\text{mA}$ .

## Electrical Characteristics at 1000mA, Junction Temperature, $T_J = 25^\circ\text{C}$

Table 9.

| Color      | Typical Forward Voltage<br>$V_F$ (V) <sup>[1]</sup><br>1000 mA |
|------------|----------------------------------------------------------------|
|            |                                                                |
| White      | 3.90                                                           |
| Green      | 3.90                                                           |
| Cyan       | 3.90                                                           |
| Blue       | 3.90                                                           |
| Royal Blue | 3.90                                                           |

Notes for Table 9:

1. Proper current derating must be observed to maintain junction temperature below the maximum. For more information, consult the Luxeon Design Guide, available upon request.
2. Allowable board temperature to avoid exceeding maximum junction temperature at maximum  $V_f$  limit at 700 mA based on thermal resistance of Star assembly.
3. LEDs are not designed to be driven in reverse bias. Please consult Lumileds' Application Brief AB11 for further information.

## Electrical Characteristics at 1400mA, Junction Temperature, $T_J = 25^{\circ}\text{C}$

Table 10.

| Color      | Forward Voltage $V_F$ (V) <sup>[1]</sup> |      |      | Dynamic Resistance <sup>[2]</sup><br>( $\Omega$ ) $R_D$ | Temperature Coefficient of Forward Voltage <sup>[3]</sup><br>(mV/ $^{\circ}\text{C}$ )<br>$\Delta V_F / \Delta T_J$ | Thermal Resistance, Junction to Board<br>( $^{\circ}\text{C}/\text{W}$ ) $R_{\theta_{J-B}}$ |
|------------|------------------------------------------|------|------|---------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
|            | Min.                                     | Typ. | Max. |                                                         |                                                                                                                     |                                                                                             |
| Red        | 2.31                                     | 2.95 | 3.51 | 0.7                                                     | -2.0                                                                                                                | 10                                                                                          |
| Red-Orange | 2.31                                     | 2.95 | 3.51 | 0.7                                                     | -2.0                                                                                                                | 10                                                                                          |
| Amber      | 2.31                                     | 2.95 | 3.51 | 0.7                                                     | -2.0                                                                                                                | 10                                                                                          |

Notes for Table 10:

1. Lumileds maintains a tolerance of  $\pm 0.06\text{V}$  on forward voltage measurements.
2. Dynamic resistance is the inverse of the slope in linear forward voltage model for LEDs. See Figure 3.
3. Measured between  $25^{\circ}\text{C} \leq T_J \leq 110^{\circ}\text{C}$  at  $I_F = 1400\text{mA}$ .

## Absolute Maximum Ratings

Table 11.

| Parameter                                            | White/Green/<br>Cyan/Blue/<br>Royal Blue | Red/<br>Red-Orange/<br>Amber |
|------------------------------------------------------|------------------------------------------|------------------------------|
| DC Forward Current (mA) <sup>[1]</sup>               | 1000                                     | 1540                         |
| Peak Pulsed Forward Current (mA)                     | 1000                                     | 2200                         |
| Average Forward Current (mA)                         | 1000                                     | 1400                         |
| LED Junction Temperature ( $^{\circ}\text{C}$ )      | 135                                      | 135                          |
| Storage Operating Temperature ( $^{\circ}\text{C}$ ) | -40 to +120                              | -40 to +120                  |
| ESD Sensitivity <sup>[2]</sup>                       | $\pm 16,000\text{V}$ HBM                 | $\pm 16,000\text{V}$ HBM     |

Notes for Table 11:

1. Proper current derating must be observed to maintain junction temperature below the maximum. For more information, consult the Luxeon Design Guide, available upon request.
2. LEDs are not designed to be driven in reverse bias. Please consult Lumileds' Application Brief AB11 for further information.

## Wavelength Characteristics, $T_J = 25^\circ\text{C}$

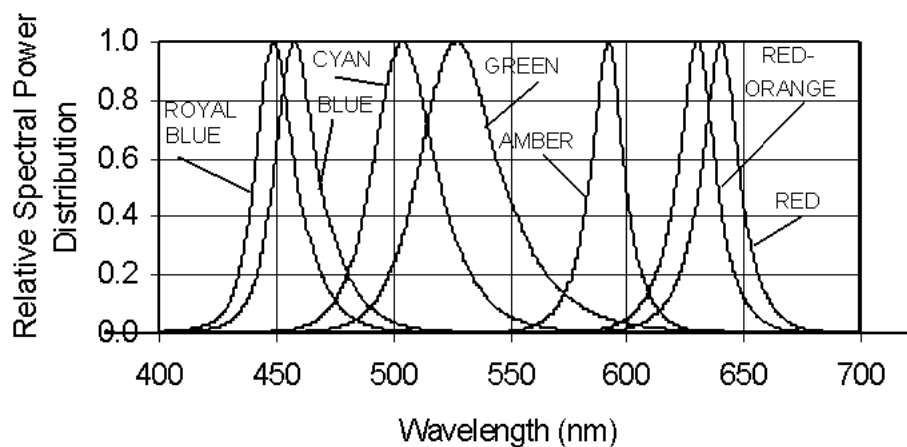


Figure 1a. Relative Intensity vs. Wavelength

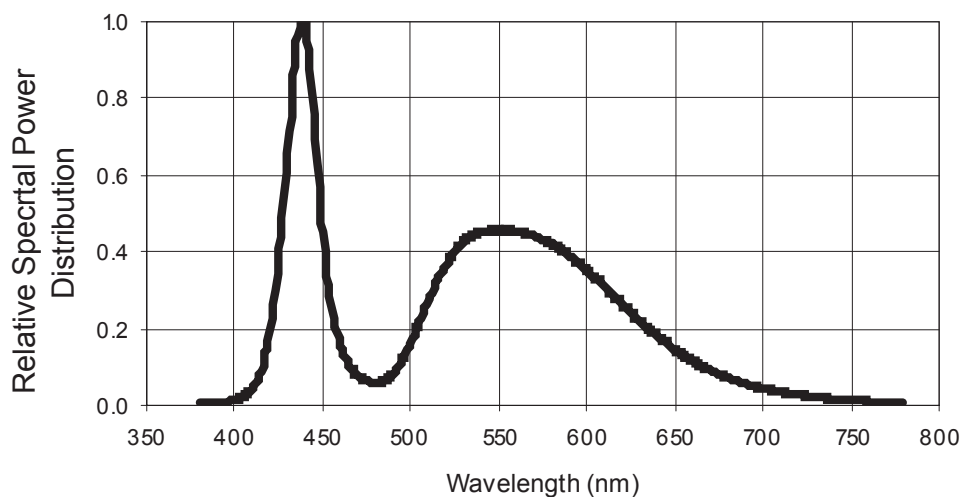


Figure 1b. White Color Spectrum of Typical 5500K CCT Part, Integrated Measurement.



## Light Output Characteristics

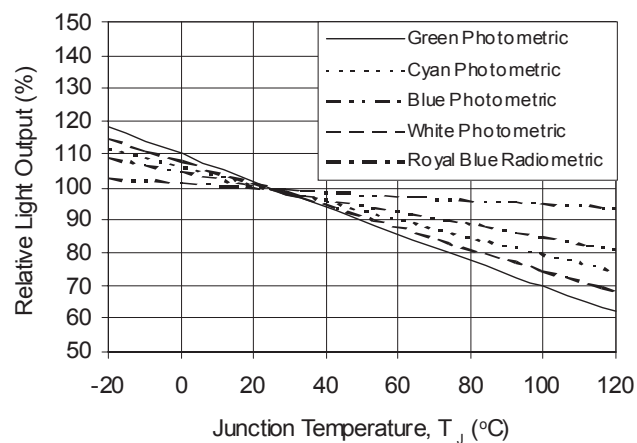


Figure 2. Relative Light Output vs. Junction Temperature for White, Green, Cyan, Blue and Royal Blue.

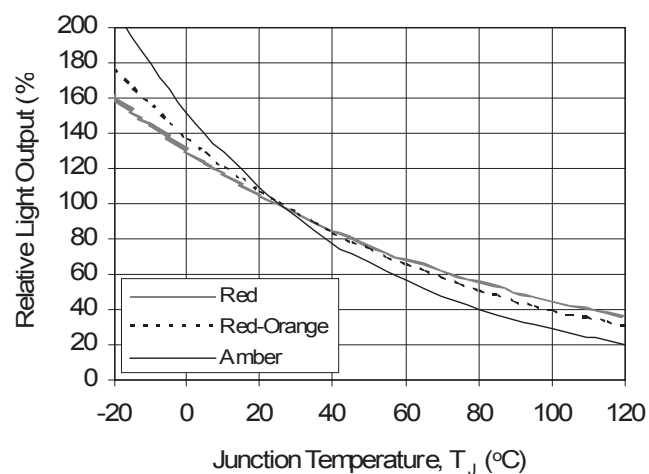


Figure 3. Relative Light Output vs. Junction Temperature for Red, Red-Orange and Amber.

## Forward Current Characteristics, $T_J = 25^\circ\text{C}$

Note:

Driving these high power devices at currents less than the test conditions may produce unpredictable results and may be subject to variation in performance. Pulse width modulation (PWM) is recommended for dimming effects.

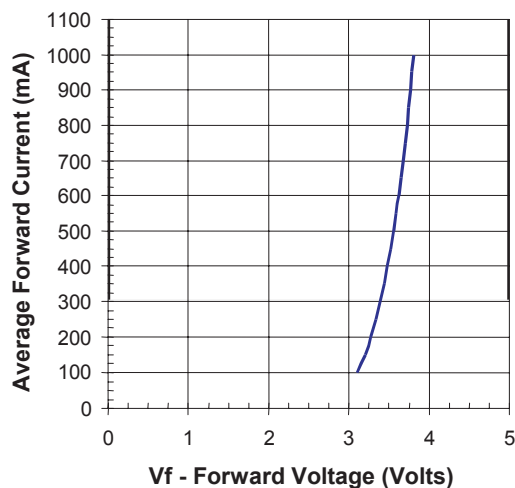


Figure 4. Forward Current vs. Forward Voltage for White, Green, Cyan, Blue, and Royal Blue.

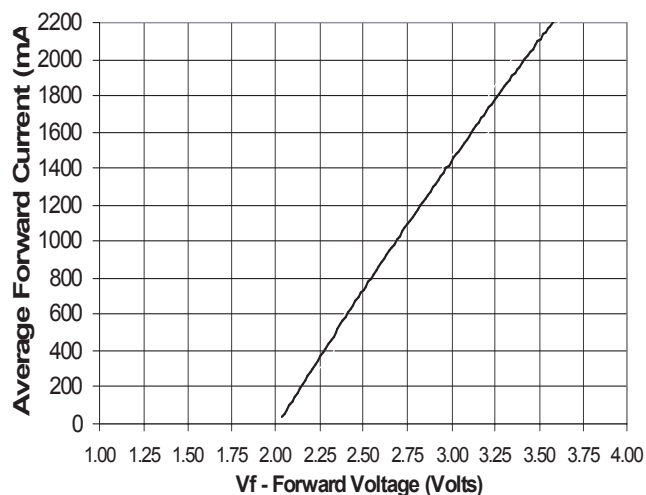


Figure 5. Forward Current vs. Forward Voltage for Red, Red-Orange and Amber.

## Forward Current Characteristics, $T_J = 25^\circ\text{C}$ , Continued

Note:

Driving these high power devices at currents less than the test conditions may produce unpredictable results and may be subject to variation in performance. Pulse width modulation (PWM) is recommended for dimming effects.

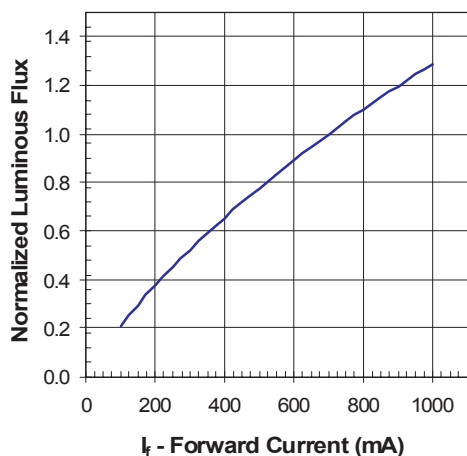


Figure 6. Relative Luminous Flux vs. Forward Current for White, Green, Cyan, Blue, and Royal Blue at  $T_J = 25^\circ\text{C}$  maintained.

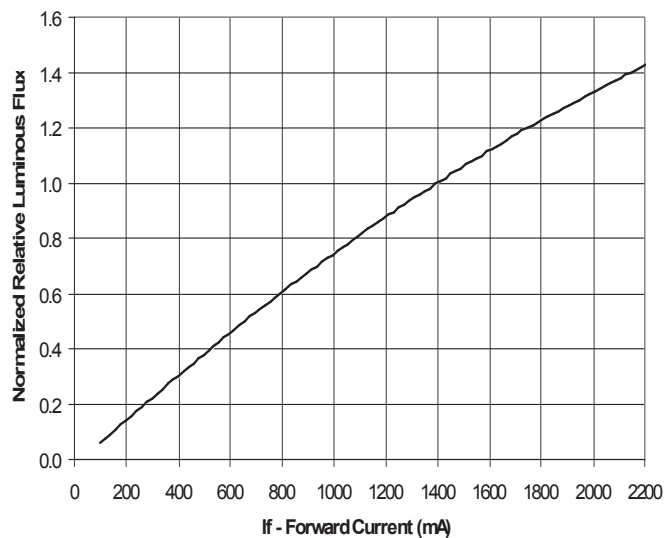


Figure 7. Relative Luminous Flux vs. Forward Current for Red, Red-Orange and Amber at  $T_J = 25^\circ\text{C}$  maintained.

## Current Derating Curves

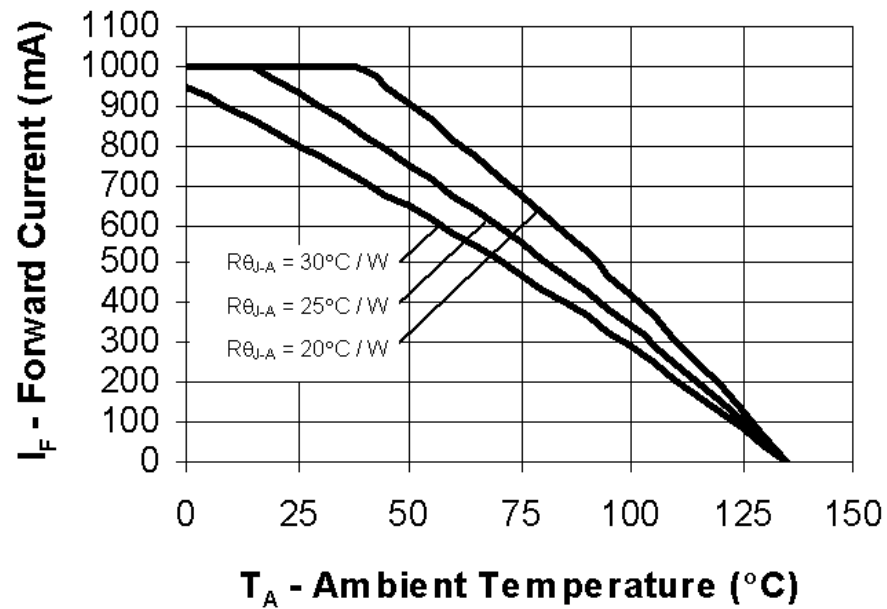


Figure 8. Maximum Forward Current vs. Ambient Temperature.

Derating based on  $T_{JMAX} = 135^\circ\text{C}$  for White, Green, Cyan, Blue, and Royal Blue. Since Luxeon III may be driven at up to 1000mA, derating curves may not be applicable for all operating conditions.

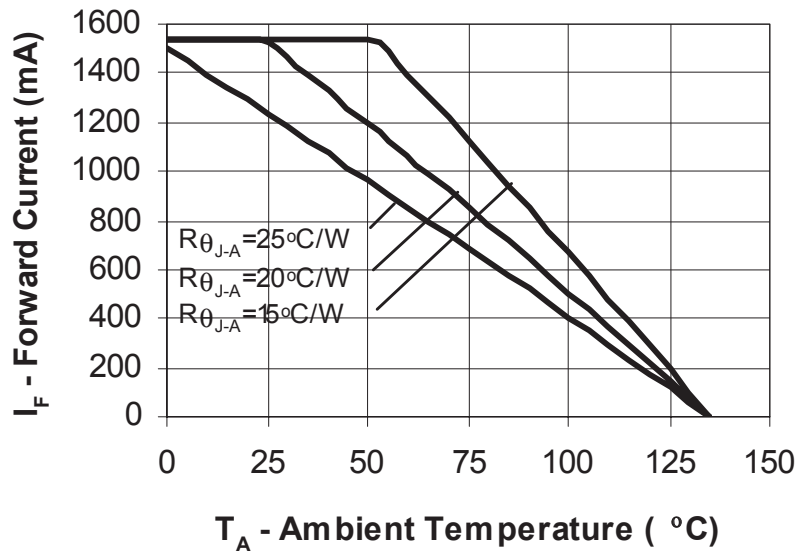


Figure 9. Maximum Forward Current vs. Ambient Temperature.

Derating based on  $T_{JMAX} = 135^\circ\text{C}$  for Red, Red-Orange, and Amber.

## Typical Lambertian Representative Spatial Radiation Pattern

Note:

For more detailed technical information regarding Luxeon radiation patterns, please consult your Lumileds Authorized Distributor or Lumileds sales representative.

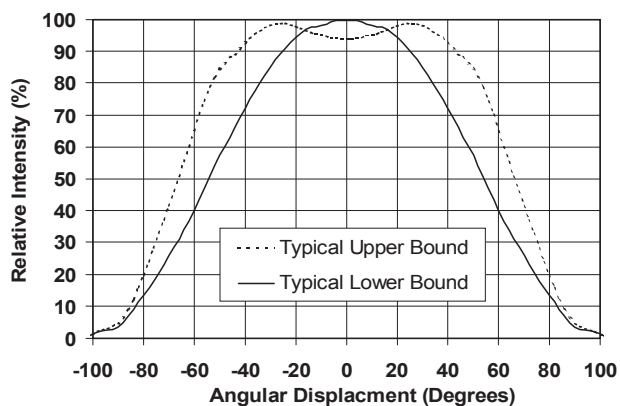


Figure 10. Typical Representative Spatial Radiation Pattern for Luxeon Emitter White, Green, Cyan, Blue and Royal Blue.

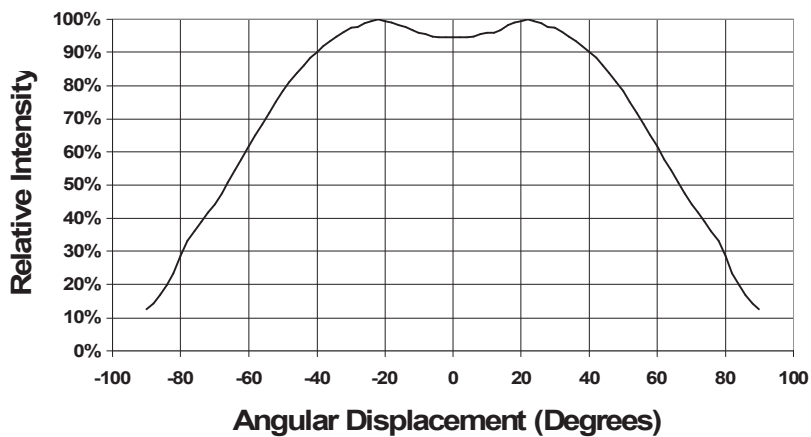


Figure 11. Typical Representative Spatial Radiation Pattern for Luxeon Lambertian Emitter Red, Red-Orange and Amber.

## Typical Side Emitting Representative Spatial Radiation Pattern

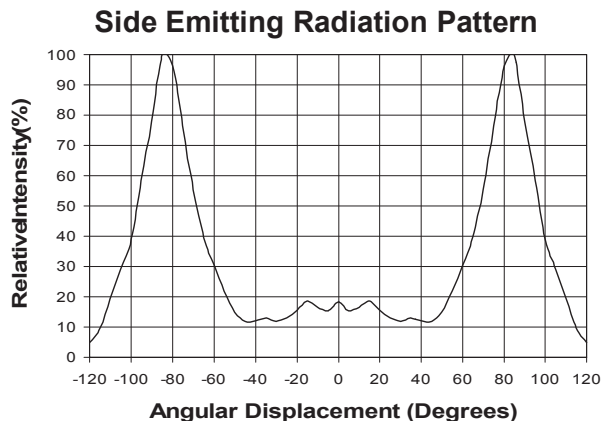


Figure 12. Typical Representative Spatial Radiation Pattern for Luxeon Emitter White, Green and Blue..

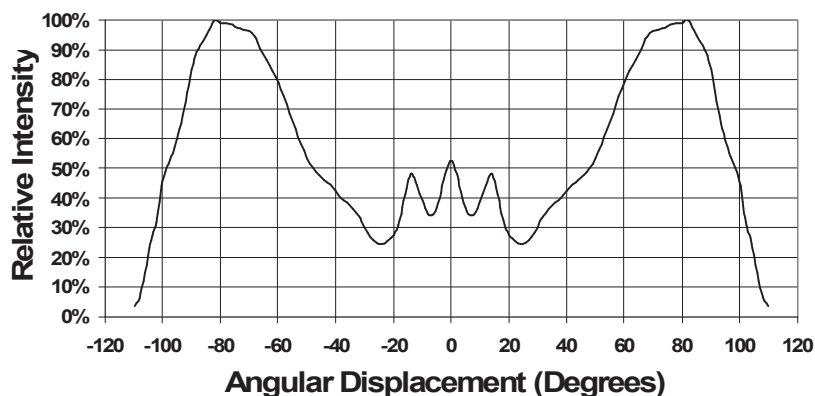


Figure 13. Typical Representative Spatial Radiation Pattern for Luxeon Side Emitting Emitter Red, Red-Orange and Amber.

## Average Lumen Maintenance Characteristics

Lifetime for solid-state lighting devices (LEDs) is typically defined in terms of lumen maintenance—the percentage of initial light output remaining after a specified period of time. Lumileds projects that white, green, cyan, blue, and royal blue Luxeon III products will deliver, on average, 70% lumen maintenance at 50,000 hours of operation at a 700 mA forward current or 50% lumen maintenance at 20,000 hours of operation at a 1000 mA forward current. Lumileds projects that red, red-orange, and amber Luxeon III products will deliver, on average 50% lumen maintenance at 20,000 hours of operation at a 1400 mA forward current. This performance is based on independent test data, Lumileds historical data from tests run on similar material systems, and internal Luxeon reliability testing. This projection is based on constant current operation with junction temperature maintained at or below 90°C. Observation of design limits included in this data sheet is required in order to achieve this projected lumen maintenance.

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