# Cree® XLamp® ML-E LEDs

## PRODUCT DESCRIPTION

The Cree XLamp ML-E LED brings lighting-class reliability and performance to 1/2-watt LEDs. The XLamp ML-E expands Cree's lighting-class leadership to LED bulbs and linear and distributed lighting applications. With XLamp lighting-class reliability, a wide viewing angle, uniform light output, and industry-leading chromaticity binning in a 3.5-mm X 3.5-mm package, the XLamp ML-E LED continues Cree's history of segment-focused product innovation in LEDs for lighting applications.

The XLamp ML-E LED brings high performance and a smooth look to a wide range of lighting applications, including linear lighting, LED light bulbs, fluorescent retrofits and retail-display lighting.

## FEATURES

- Available in white (2600 K to 8300 K CCT), 80-, 85- and 90-CRI minimum
- Available in blue, green and red
- Available in parallel and series
- ANSI-compatible sub-bins
- Maximum drive current: 500 mA for parallel white, 167 mA for series white, 350 mA for color
- 120° viewing angle for white and red, 125° viewing angle for blue and green
- Uniform chromaticity profile
- Electrically neutral thermal path
- Unlimited floor life at ≤ 30 °C/85% RH
- RoHS- and REACh-compliant
- UL-recognized component (E349212)

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## FLUX CHARACTERISTICS - ML-E PARALLEL WHITE ($T_J$ = 25 °C)

The following table provides several base order codes for XLamp ML-E LEDs. It is important to note that the base order codes listed here are a subset of the total available order codes for the product family. For more order codes, as well as a complete description of the order-code nomenclature, please consult the XLamp ML-E LED Binning and Labeling document.

| Color | CCT Range | | Base Order Codes Minimum Luminous Flux (lm) @ 150 mA | | Calculated Minimum Luminous Flux (lm)* | | Order Code |
|---|---|---|---|---|---|---|---|
| | Min. | Max. | Group | Flux (lm) | 350 mA | 500 mA | |
| Cool White | 5000 K | 8300 K | M3 | 45.7 | 92.6 | 117.4 | MLEAWT-A1-0000-000351 |
| | | | N2 | 51.7 | 104.8 | 132.9 | MLEAWT-A1-0000-000451 |
| 80-CRI Cool White | 6000 K | 7000 K | M3 | 45.7 | 92.6 | 117.4 | MLEAWT-H1-0000-0003E1 |
| | 4750 K | 5250 K | M3 | 45.7 | 92.6 | 117.4 | MLEAWT-H1-0000-0003E3 |
| Warm White | 3700 K | 4300 K | M2 | 39.8 | 80.7 | 102.3 | MLEAWT-A1-0000-0002E5 |
| | | | M3 | 45.7 | 92.6 | 117.4 | MLEAWT-A1-0000-0003E5 |
| | 2800 K | 3200 K | K3 | 35.2 | 71.4 | 90.5 | MLEAWT-A1-0000-0001E7 |
| | | | M2 | 39.8 | 80.7 | 102.3 | MLEAWT-A1-0000-0002E7 |
| 80-CRI Warm White | 3700 K | 4300 K | M2 | 39.8 | 80.7 | 102.3 | MLEAWT-H1-0000-0002E5 |
| | 2800 K | 3200 K | K3 | 35.2 | 71.4 | 90.5 | MLEAWT-H1-0000-0001E7 |
| 85-CRI Warm White | 2800 K | 3200 K | K3 | 35.2 | 71.4 | 90.5 | MLEAWT-P1-0000-0001E7 |
| 90-CRI Warm White | 2800 K | 3200 K | K2 | 30.6 | 62 | 78.6 | MLEAWT-U1-0000-0000E7 |

Notes:

- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and ±2 on CRI measurements.
- Typical CRI for Cool White (4,300 K – 8,300 K CCT) is 75.
- Typical CRI for Warm White (2,600 K – 4,300 K CCT) is 80.
- Minimum CRI for 80-CRI White is 80.
- Minimum CRI for 85-CRI White is 85.
- Minimum CRI for 90-CRI White is 90

* Calculated flux values are for reference only.

## FLUX CHARACTERISTICS - ML-E SERIES WHITE ($T_J$ = 25 °C)

The following table provides several base order codes for XLamp ML-E LEDs. It is important to note that the base order codes listed here are a subset of the total available order codes for the product family. For more order codes, as well as a complete description of the order-code nomenclature, please consult the XLamp ML-E LED Binning and Labeling document.

| Color | CCT Range | | Base Order Codes Minimum Luminous Flux (lm) @ 50 mA | | Calculated Minimum Luminous Flux (lm)* | | Order Code |
|---|---|---|---|---|---|---|---|
| | Min. | Max. | Group | Flux (lm) | 117 mA | 166 mA | |
| Cool White | 5000 K | 8300 K | M3 | 45.7 | 92.6 | 117.4 | MLESWT-A1-0000-000351 |
| | | | N2 | 51.7 | 104.8 | 132.9 | MLESWT-A1-0000-000451 |
| 80-CRI Cool White | 6000 K | 7000 K | M3 | 45.7 | 92.6 | 117.4 | MLESWT-H1-0000-0003E1 |
| | 4750 K | 5250 K | M3 | 45.7 | 92.6 | 117.4 | MLESWT-H1-0000-0003E3 |
| Warm White | 3700 K | 4300 K | M2 | 39.8 | 80.7 | 102.3 | MLESWT-A1-0000-0002E5 |
| | | | M3 | 45.7 | 92.6 | 117.4 | MLESWT-A1-0000-0003E5 |
| | 2800 K | 3200 K | K3 | 35.2 | 71.4 | 90.5 | MLESWT-A1-0000-0001E7 |
| | | | M2 | 39.8 | 80.7 | 102.3 | MLESWT-A1-0000-0002E7 |
| 80-CRI Warm White | 3700 K | 4300 K | M2 | 39.8 | 80.7 | 102.3 | MLESWT-H1-0000-0002E5 |
| | 2800 K | 3200 K | K3 | 35.2 | 71.4 | 90.5 | MLESWT-H1-0000-0001E7 |
| 85-CRI Warm White | 2800 K | 3200 K | K3 | 35.2 | 71.4 | 90.5 | MLESWT-P1-0000-0001E7 |
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Notes:

- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and ±2 on CRI measurements.
- Typical CRI for Cool White (4,300 K – 8,300 K CCT) is 75.
- Typical CRI for Warm White (2,600 K – 4,300 K CCT) is 80.
- Minimum CRI for 80-CRI White is 80.
- Minimum CRI for 85-CRI White is 85.
- Minimum CRI for 90-CRI White is 90.

* Calculated flux values are for reference only.

## FLUX CHARACTERISTICS ($T_J$ = 25 °C) - COLOR

The following table provides several base order codes for XLamp ML-E LEDs. It is important to note that the base order codes listed here are a subset of the total available order codes for the product family. For more order codes, as well as a complete description of the order-code nomenclature, please consult the XLamp ML Family Binning and Labeling document.

| Color | Dominant Wavelength Range | | | | Base Order Codes Minimum Luminous Flux (lm) @ 150 mA | | Order Code |
|---|---|---|---|---|---|---|---|
| | Min. | | Max. | | | | |
| | Group | DWL (nm) | Group | DWL (nm) | Group | Flux (lm) | |
| Blue | B3 | 465 | B6 | 485 | F0 | 10.7 | MLEBLU-A1-0000-000T01 |
| | | | | | G0 | 13.9 | MLEBLU-A1-0000-000U01 |

| Color | Dominant Wavelength Range | | | | Base Order Codes Minimum Luminous Flux (lm) @ 150 mA | | Order Code |
|---|---|---|---|---|---|---|---|
| | Min. | | Max. | | | | |
| | Group | DWL (nm) | Group | DWL (nm) | Group | Flux (lm) | |
| Green | G2 | 520 | G4 | 535 | J3 | 26.8 | MLEGRN-A1-0000-000X01 |
| | | | | | K2 | 30.6 | MLEGRN-A1-0000-000001 |
| | | | | | K3 | 35.2 | MLEGRN-A1-0000-000101 |

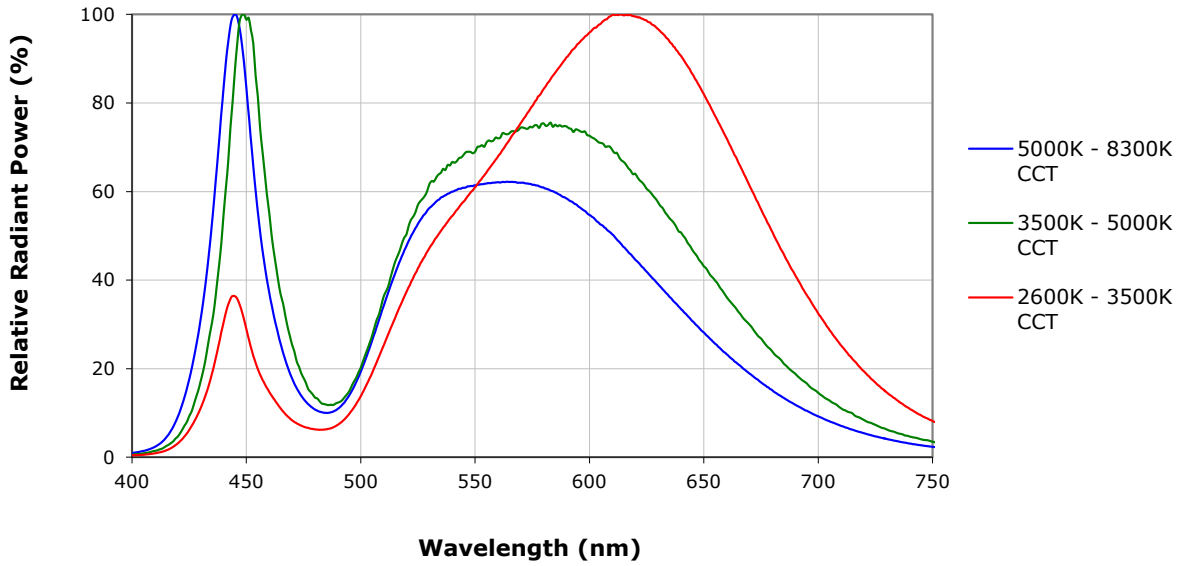
| Color | Dominant Wavelength Range | | | | Base Order Codes Minimum Luminous Flux (lm) @ 150 mA | | Order Code |
|---|---|---|---|---|---|---|---|
| | Min. | | Max. | | | | |
| | Group | DWL (nm) | Group | DWL (nm) | Group | Flux (lm) | |
| Red | R2 | 620 | R3 | 630 | H0 | 18.1 | MLERED-A1-0000-000V01 |
| | | | | | J0 | 23.5 | MLERED-A1-0000-000W01 |

Note: Cree maintains a tolerance of ±7% on flux and power measurements.

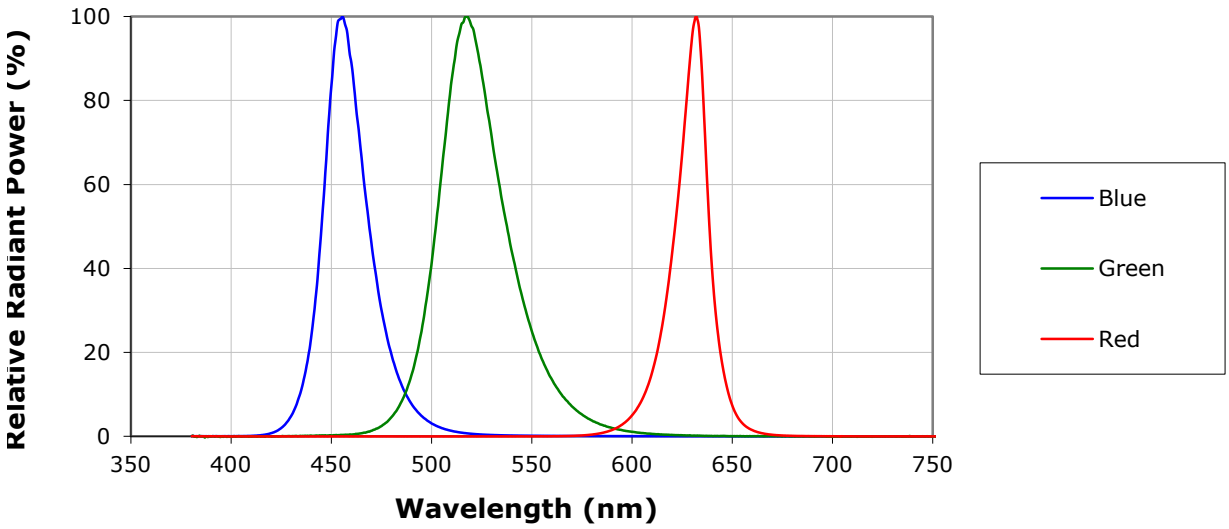
## CHARACTERISTICS ($T_J$ = 25 °C)

| Characteristics | Unit | Minimum | Typical | Maximum |
|---|---|---|---|---|
| Thermal resistance, junction to solder point - white | °C/W | | 11 | |
| Thermal resistance, junction to solder point - blue | °C/W | | 11 | |
| Thermal resistance, junction to solder point - green, red | °C/W | | 15 | |
| Viewing angle (FWHM) - white | degrees | | 120 | |
| Viewing angle (FWHM) - blue, green | degrees | | 125 | |
| Viewing angle (FWHM) - red | degrees | | 120 | |
| Temperature coefficient of voltage - parallel - white | mV/°C | | -3.3 | |
| Temperature coefficient of voltage - series - white | mV/°C | | -10 | |
| Temperature coefficient of voltage - blue | mV/°C | | -1.8 | |
| Temperature coefficient of voltage - green | mV/°C | | -3.3 | |
| Temperature coefficient of voltage - red | mV/°C | | -4 | |
| ESD classification (HBM per Mil-Std-883D) | | | Class 2 | |
| DC forward current - parallel - white | mA | | | 500 |
| DC forward current - series - white | mA | | | 167 |
| DC forward current - blue, green, red | mA | | | 350 |
| Reverse voltage | V | | | -5 |
| Forward voltage (@ 150 mA) - parallel - white | V | | 3.2 | |
| Forward voltage (@ 50 mA) - series - white | V | | 9.6 | |
| Forward voltage (@ 150 mA) - blue | V | | 3.2 | |
| Forward voltage (@ 150 mA) - green | V | | 3.45 | |
| Forward voltage (@ 150 mA) - red | V | | 2.2 | |
| LED junction temperature | °C | | | 150 |

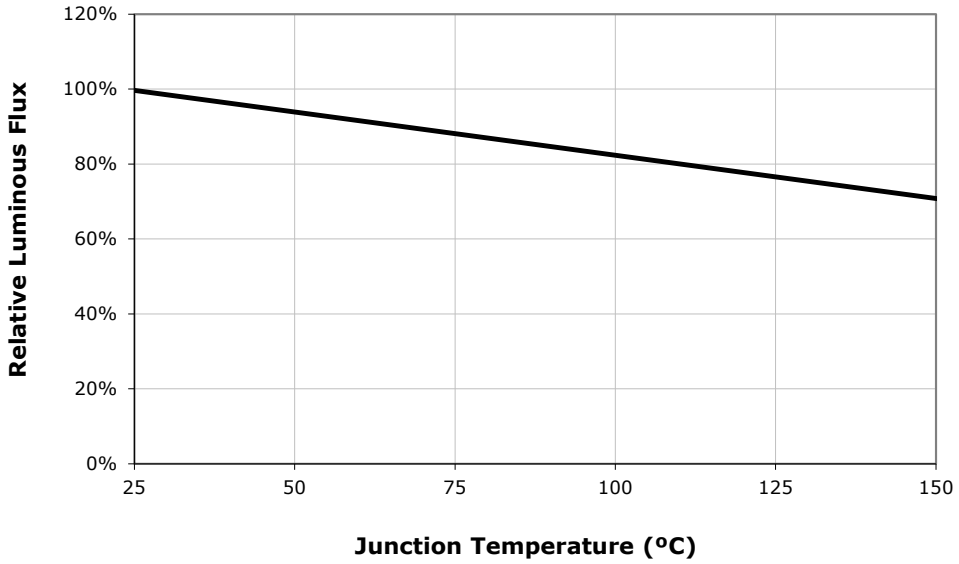
## RELATIVE SPECTRAL POWER DISTRIBUTION - WHITE



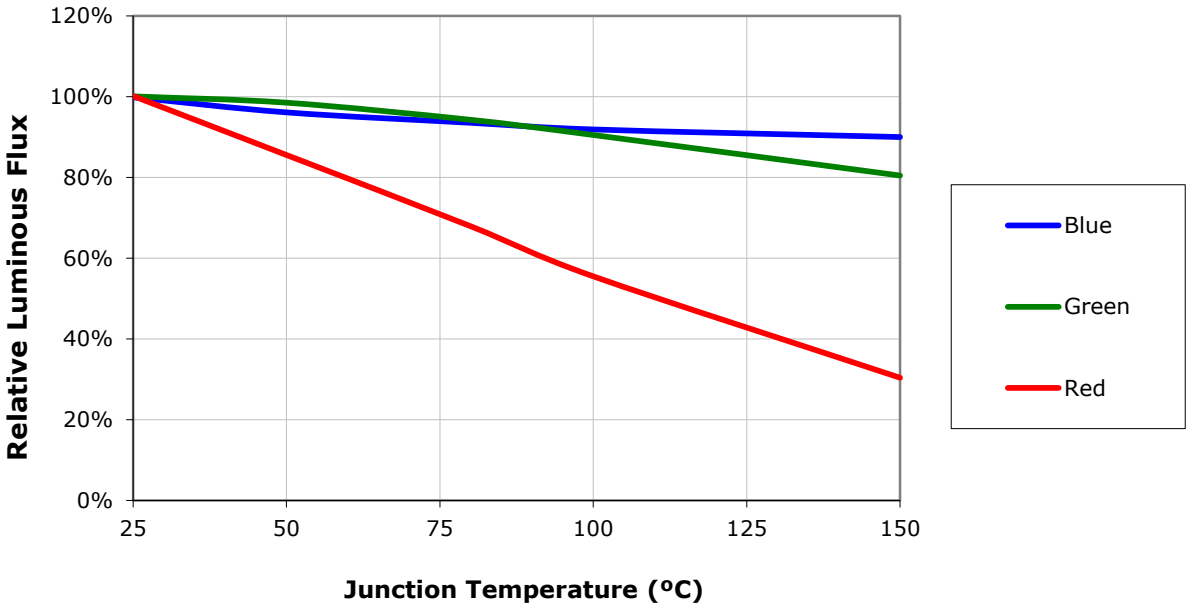

## RELATIVE SPECTRAL POWER DISTRIBUTION - COLOR



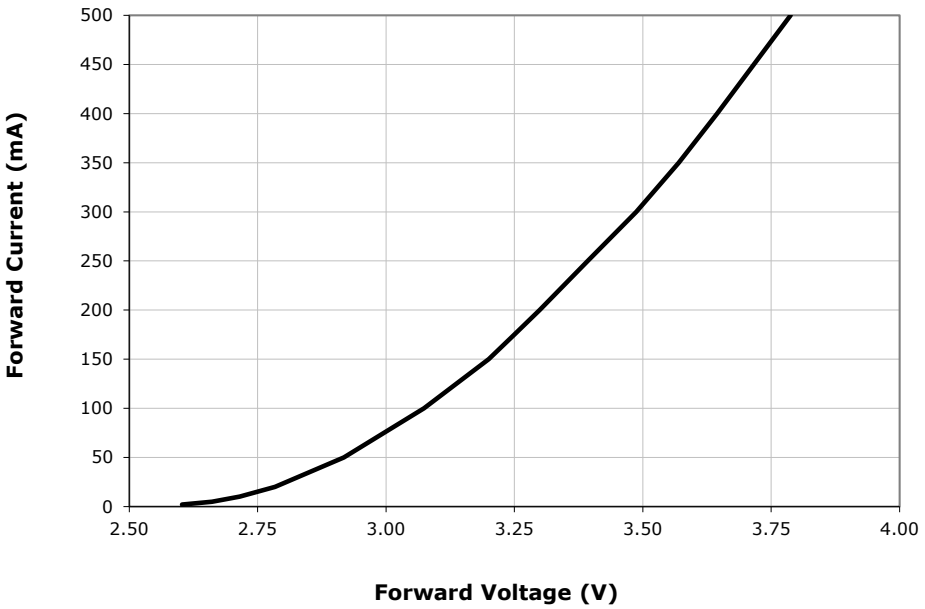
## RELATIVE FLUX VS. JUNCTION TEMPERATURE ($I_F$ = 150 mA, ML-E PARALLEL $I_F$ = 50 mA, ML-E SERIES)



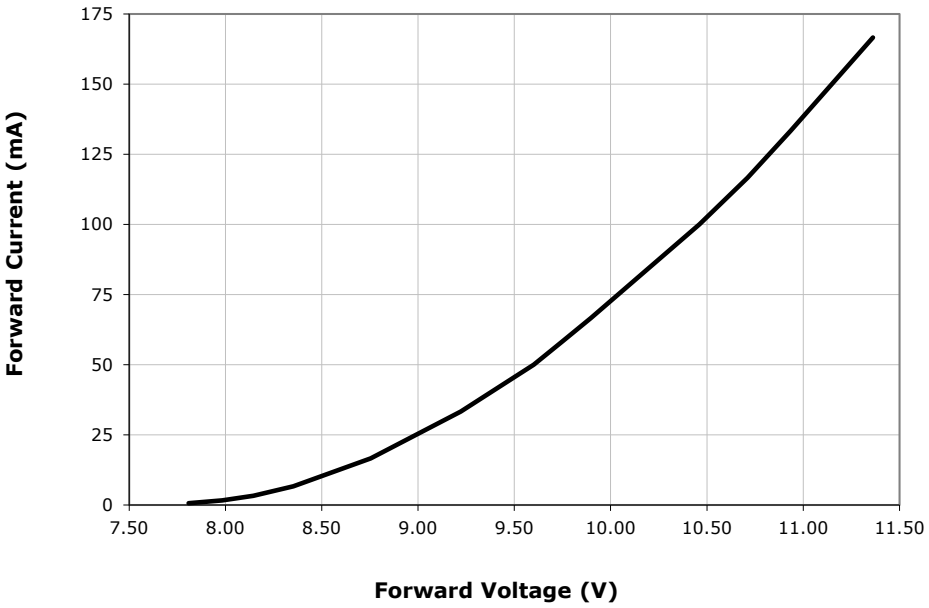

## RELATIVE FLUX VS. JUNCTION TEMPERATURE ($I_F$ = 150 mA) - COLOR



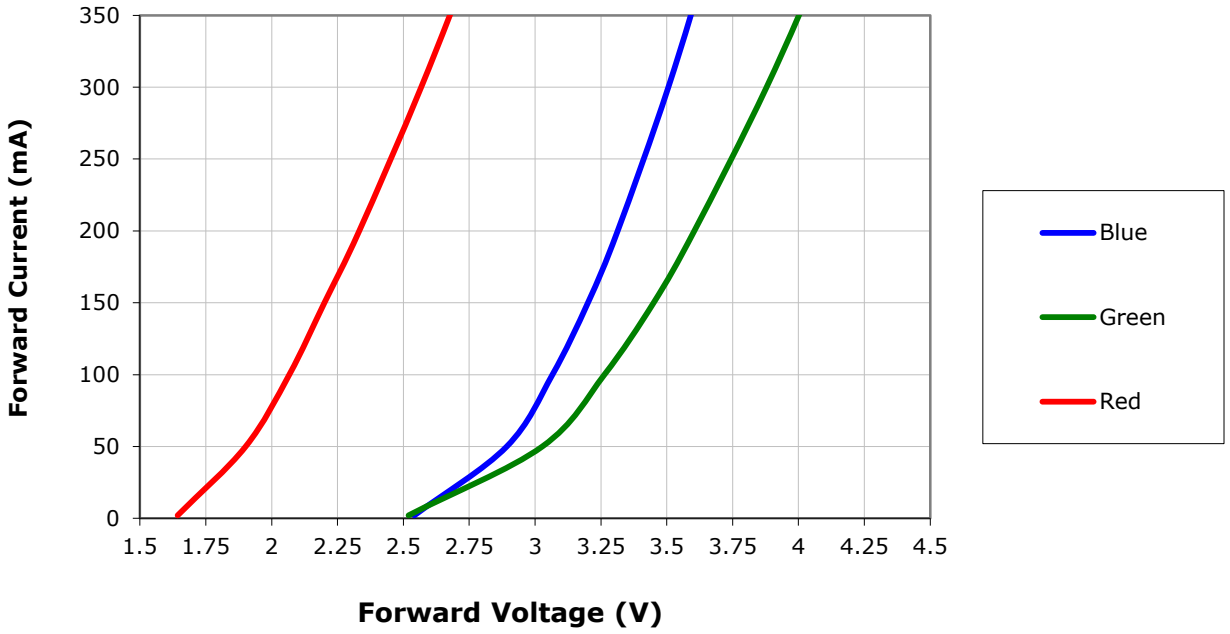
## ELECTRICAL CHARACTERISTICS - ML-E PARALLEL ($T_J$ = 25 °C) - WHITE



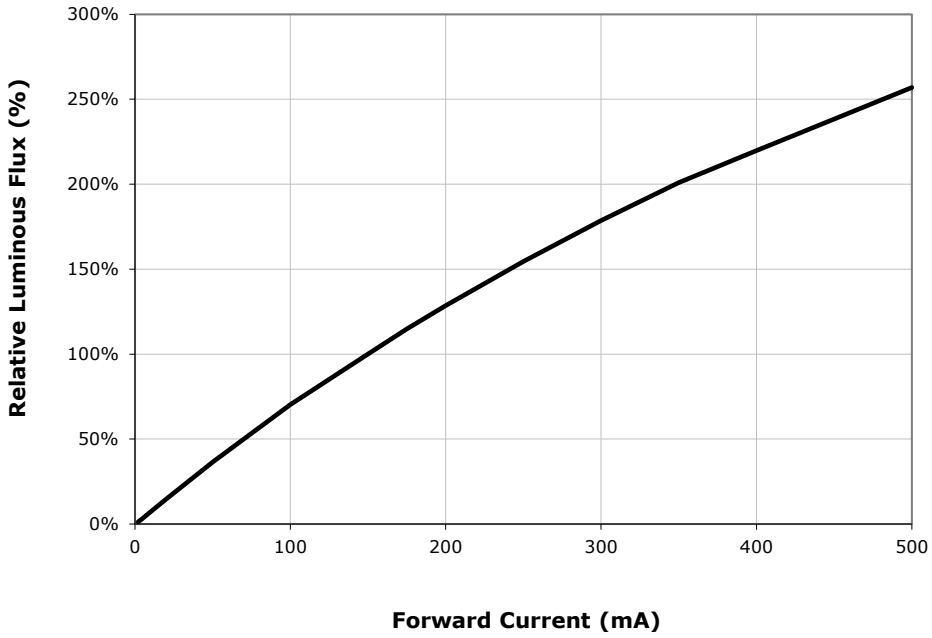

## ELECTRICAL CHARACTERISTICS - ML-E SERIES ($T_J$ = 25 °C) - WHITE



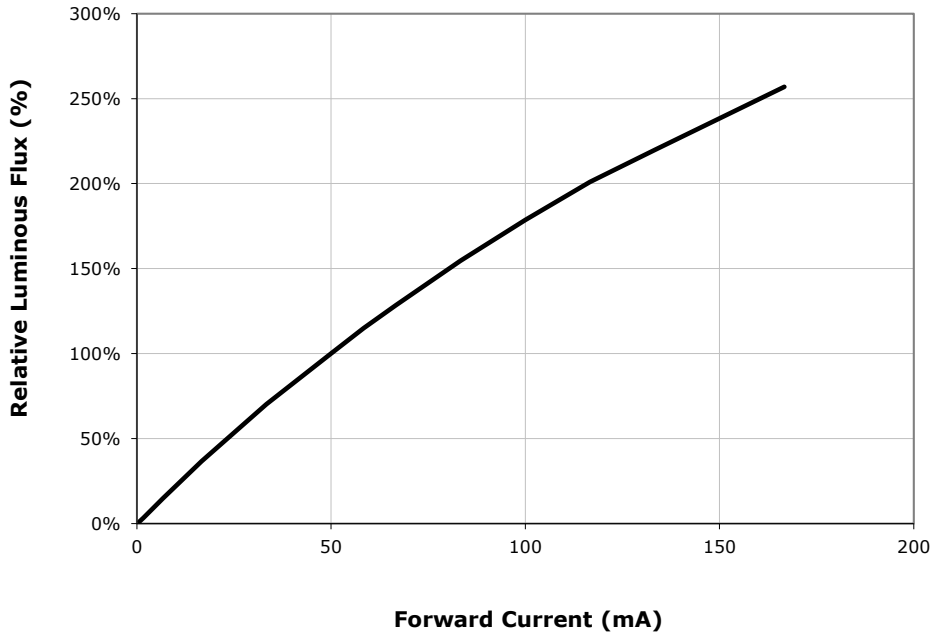
## ELECTRICAL CHARACTERISTICS ($T_J$ = 25 °C) - COLOR



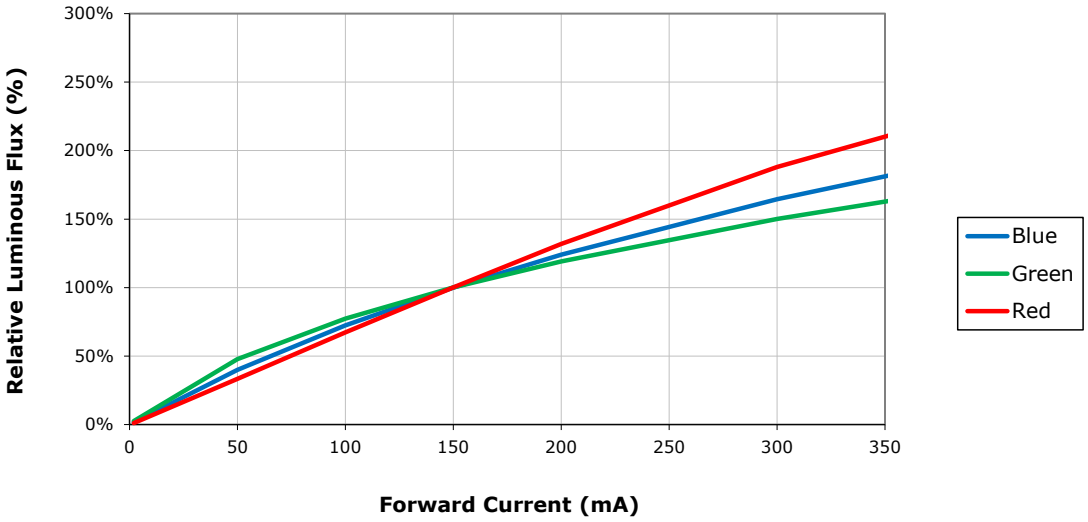

## RELATIVE FLUX VS. CURRENT - ML-E PARALLEL ($T_J$ = 25 °C) - WHITE



## RELATIVE FLUX VS. CURRENT - ML-E SERIES ($T_J$ = 25 °C) - WHITE

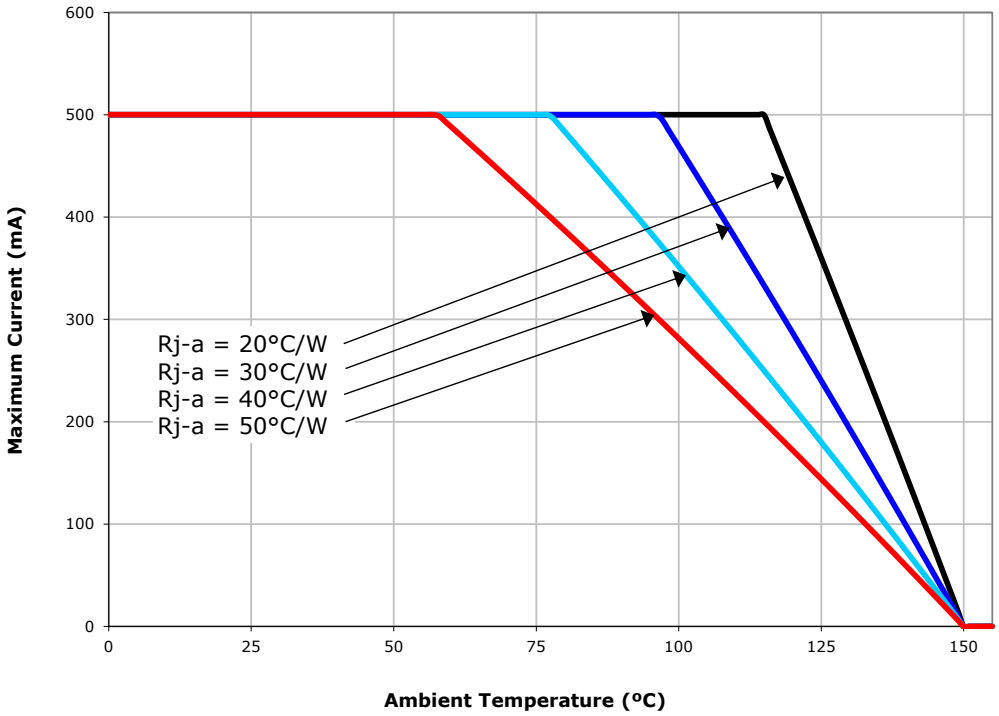



## RELATIVE FLUX VS. CURRENT ($T_J$ = 25 °C) - COLOR

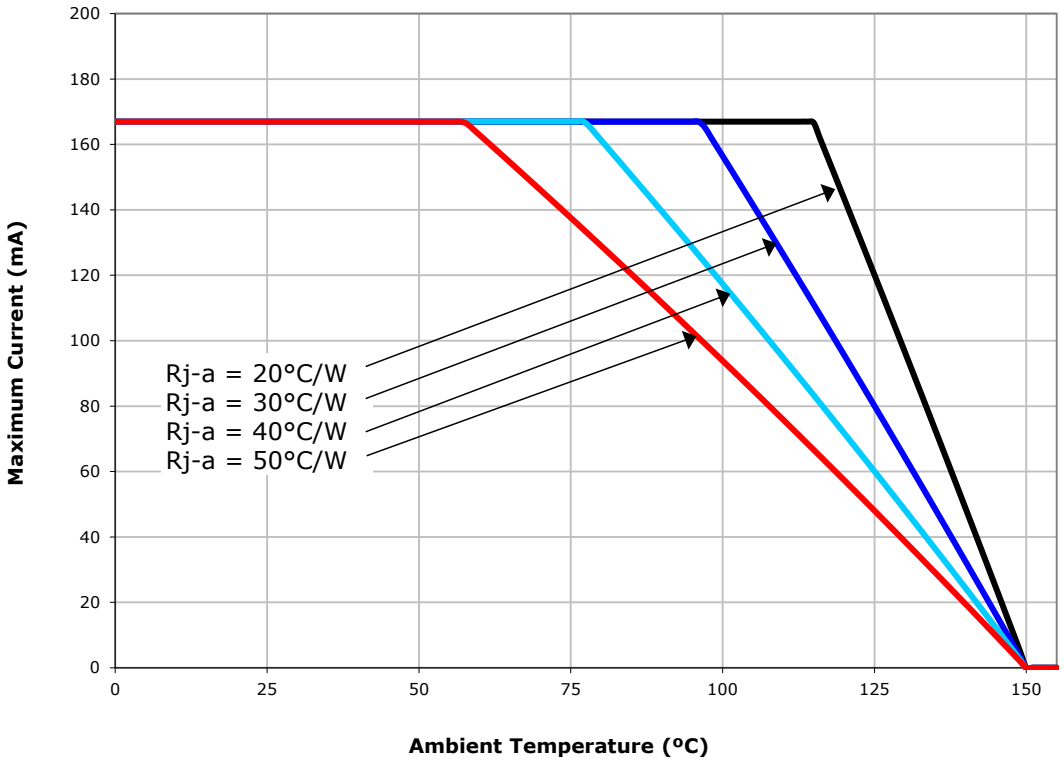


## THERMAL DESIGN - ML-E PARALLEL WHITE

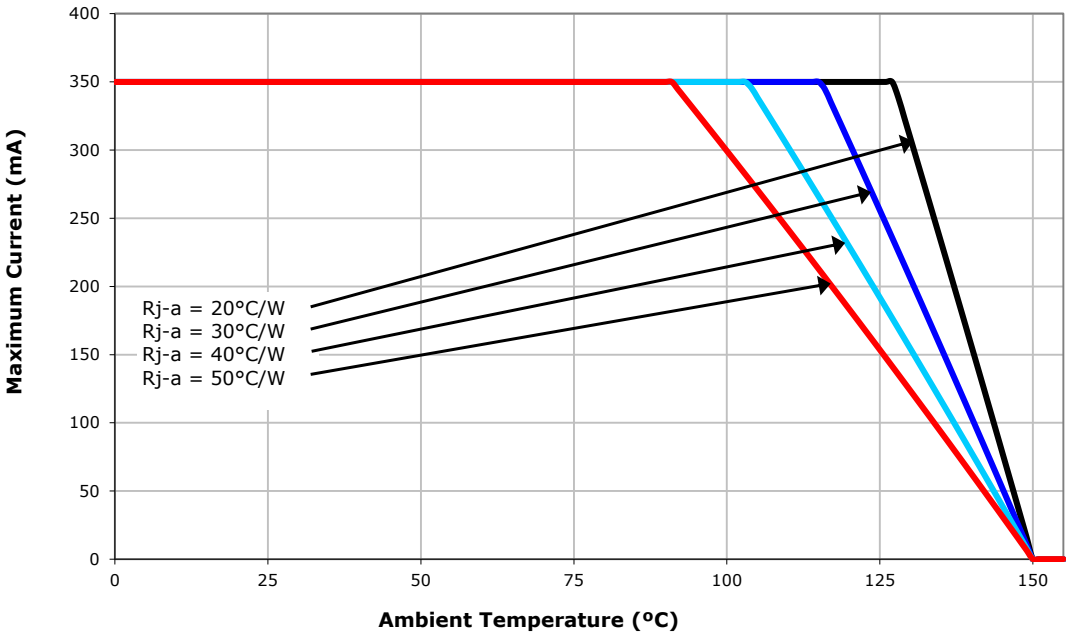
The maximum forward current is determined by the thermal resistance between the LED junction and ambient. It is crucial for the end product to be designed in a manner that minimizes the thermal resistance from the solder point to ambient in order to optimize lamp life and optical characteristics.



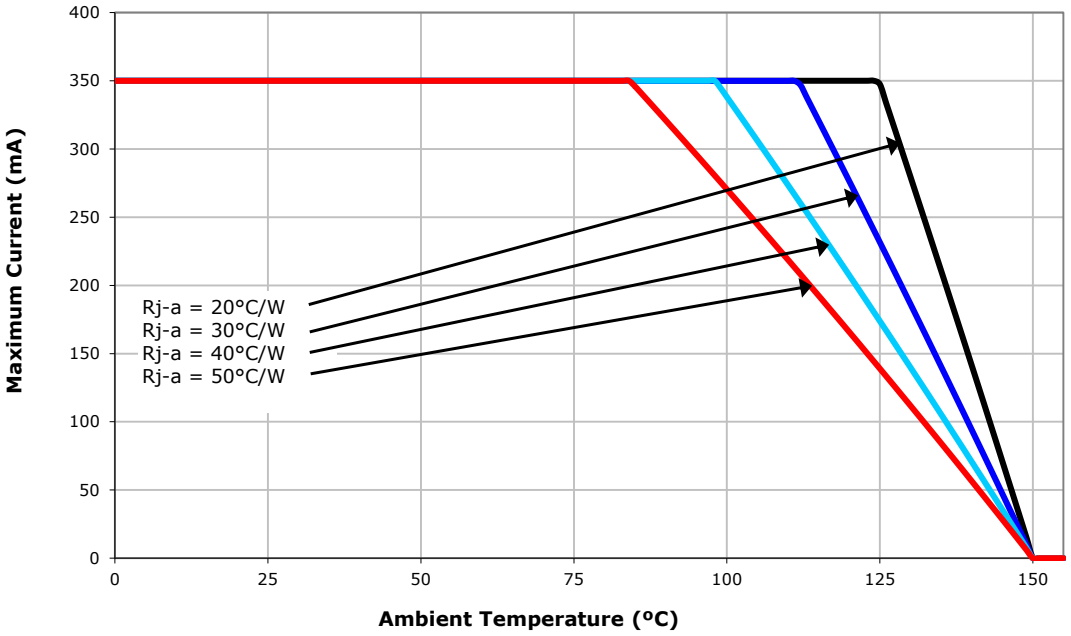
## THERMAL DESIGN - ML-E SERIES WHITE



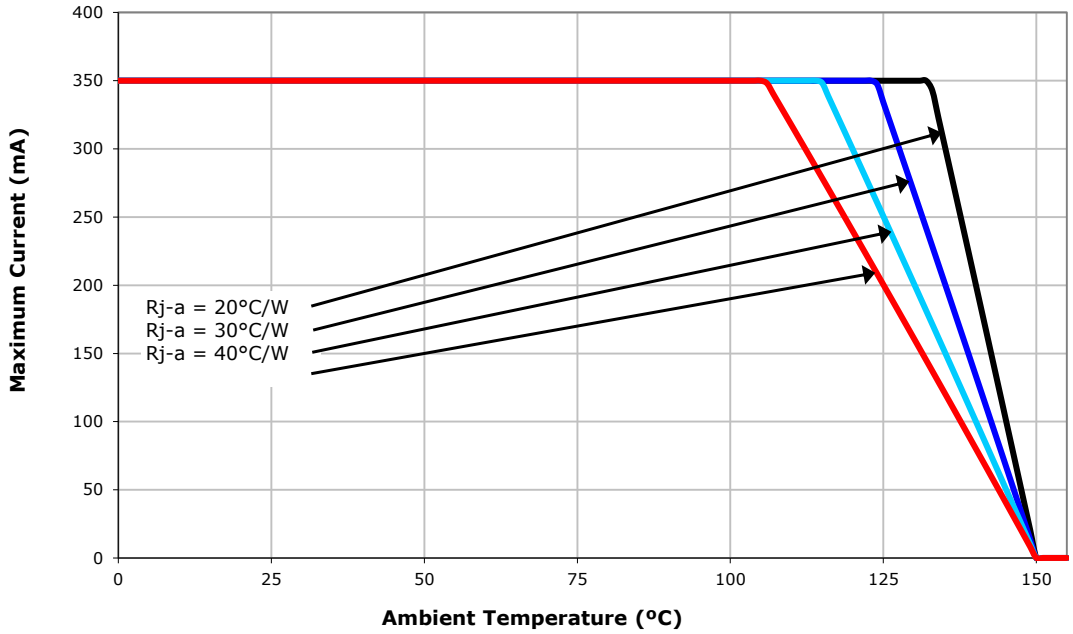

## THERMAL DESIGN - BLUE



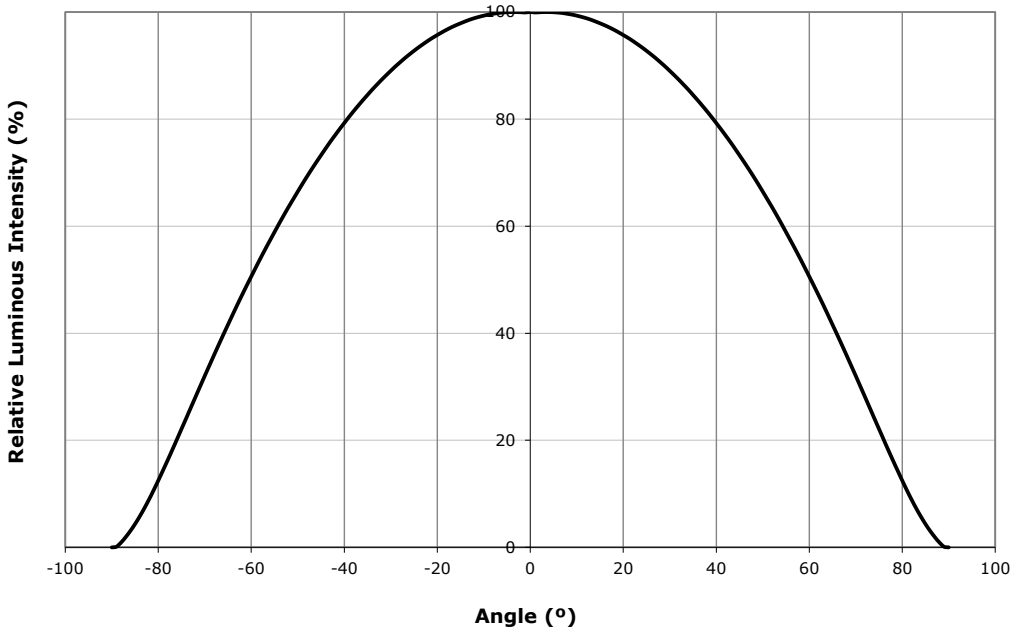
## THERMAL DESIGN - GREEN



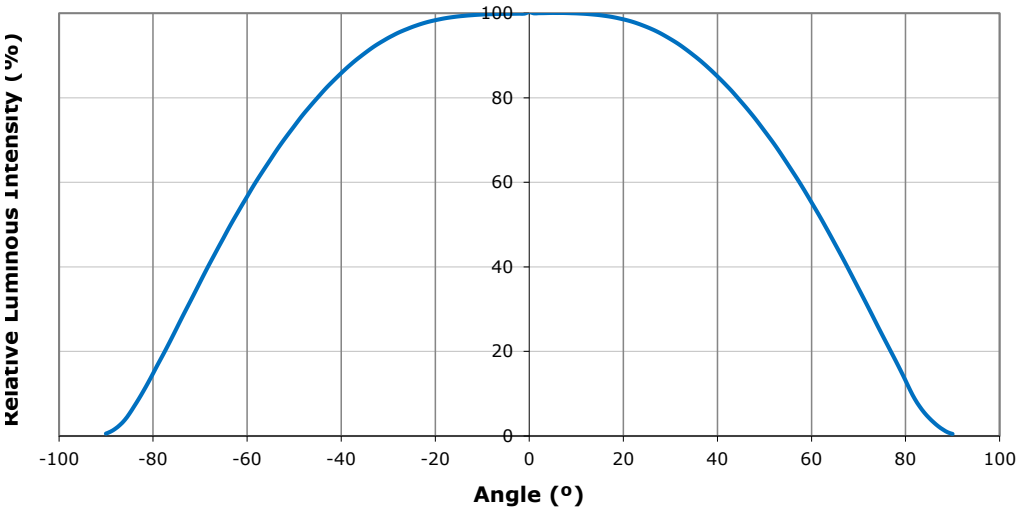

## THERMAL DESIGN - RED



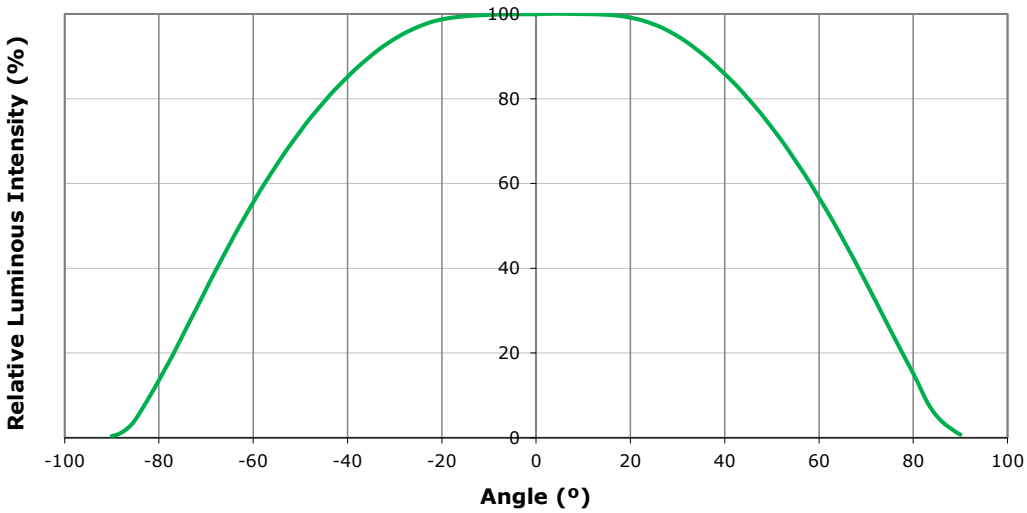
## TYPICAL SPATIAL DISTRIBUTION - WHITE



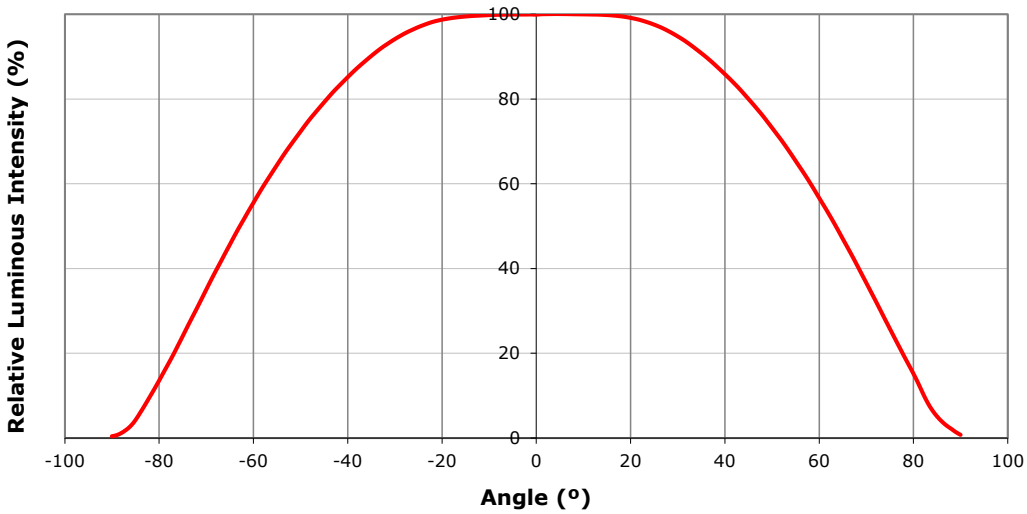

## TYPICAL SPATIAL DISTRIBUTION - BLUE



## TYPICAL SPATIAL DISTRIBUTION - GREEN



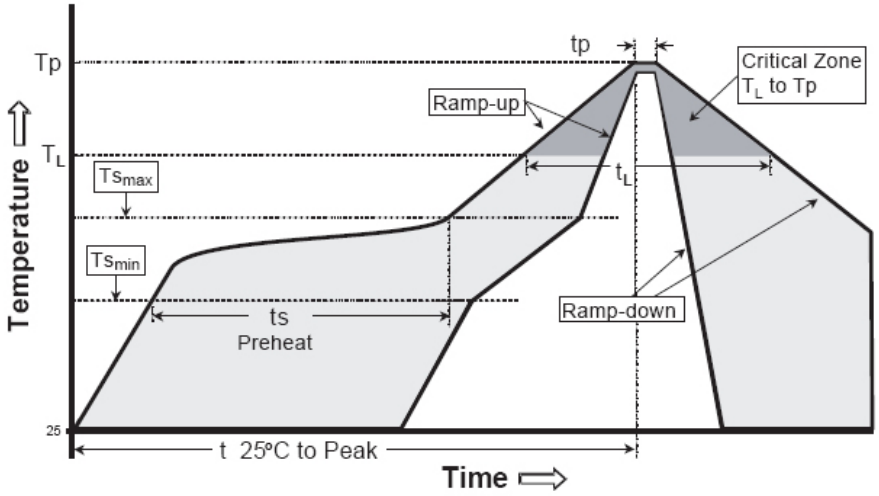

## TYPICAL SPATIAL DISTRIBUTION - RED



## REFLOW SOLDERING CHARACTERISTICS

In testing, Cree has found XLamp ML-E LEDs to be compatible with JEDEC J-STD-020C, using the parameters listed below. As a general guideline, Cree recommends that users follow the recommended soldering profile provided by the manufacturer of the solder paste used.

Note that this general guideline may not apply to all PCB designs and configurations of reflow soldering equipment.




| Profile Feature | Lead-Based Solder | Lead-Free Solder |
|---|---|---|
| Average Ramp-Up Rate ($Ts_{max}$ to Tp) | 3 °C/second max. | 3 °C/second max. |
| Preheat: Temperature Min ($Ts_{min}$) | 100 °C | 150 °C |
| Preheat: Temperature Max ($Ts_{max}$) | 150 °C | 200 °C |
| Preheat: Time ($ts_{min}$ to $ts_{max}$) | 60-120 seconds | 60-180 seconds |
| Time Maintained Above: Temperature ($T_L$) | 183 °C | 217 °C |
| Time Maintained Above: Time ($t_L$) | 60-150 seconds | 60-150 seconds |
| Peak/Classification Temperature (Tp) | 215 °C | 260 °C |
| Time Within 5 °C of Actual Peak Temperature (tp) | 10-30 seconds | 20-40 seconds |
| Ramp-Down Rate | 6 °C/second max. | 6 °C/second max. |
| Time 25 °C to Peak Temperature | 6 minutes max. | 8 minutes max. |

Note: All temperatures refer to topside of the package, measured on the package body surface.
Note: While the high reflow temperatures (above) have been approved, Cree's best practice guideline for reflow is to use as low a temperature as possible during the reflow soldering process for these LEDs.

## NOTES

### Lumen Maintenance Projections

Cree now uses standardized IES LM-80-08 and TM-21-11 methods for collecting long-term data and extrapolating LED lumen maintenance. For information on the specific LM-80 data sets available for this LED, refer to the public LM-80 results document at www.cree.com/xlamp_app_notes/LM80_results.

Cree currently recommends a maximum drive current of 175 mA for XLamp ML-E parallel white and 58 mA for XLamp ML-E series white LEDs in designs seeking the ENERGY STAR* 35,000-hour lifetime rating (≥ 94.1% luminous flux @ 6000 hours) or 25,000-hour lifetime rating (≥ 91.8% luminous flux @ 6000 hours).

Please read the XLamp Long-Term Lumen Maintenance application note at www.cree.com/xlamp_app_notes/lumen_maintenance for more details on Cree's lumen maintenance testing and forecasting. Please read the XLamp Thermal Management application note at www.cree.com/xlamp_app_notes/thermal_management for details on how thermal design, ambient temperature, and drive current affect the LED junction temperature.

* These lifetime ratings are based on the current ENERGY STAR Product Specification for Luminaires (Light Fixtures) V1.0 (February 16, 2011) and ENERGY STAR Program Requirements for Integral LED Lamps V1.4 (May 13, 2011) lumen maintenance criteria.

### Moisture Sensitivity

In testing, Cree has found XLamp ML-E LEDs to have unlimited floor life in conditions ≤ 30 ºC/85% relative humidity (RH). Moisture testing included a 168-hour soak at 85 ºC/85% RH followed by 3 reflow cycles, with visual and electrical inspections at each stage.

Cree recommends keeping XLamp LEDs in their sealed moisture-barrier packaging until immediately prior to use. Cree also recommends returning any unused LEDS to the resealable moisture-barrier bag and closing the bag immediately after use.

### RoHS Compliance

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as amended through June 8, 2011. RoHS Declarations for this product can be obtain from your Cree representative or obtained from the Product Ecology section of www.cree.com.

### REACh Compliance

REACh substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notices of their intent to frequently revise the SVHC listing for the foreseeable future, please contact a Cree representative to insure you get the most up-to-date REACh Declaration. Historical REACh banned substance information (substances restricted or banned in the EU prior to 2010) is also available upon request.

### UL Recognized Component

Level 4 enclosure consideration. The LED package or a portion thereof has been investigated as a fire and electrical enclosure per ANSI/UL 8750.

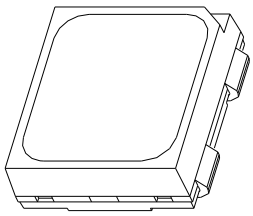
### Vision Advisory Claim

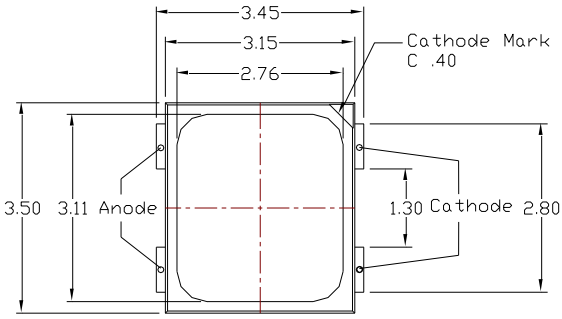
WARNING: Do not look at an exposed lamp in operation. Eye injury can result. See LED Eye Safety at www.cree.com/xlamp_app_notes/led_eye_safety.

## MECHANICAL DIMENSIONS ($T_A$ = 25 °C)

All measurements are ±.13 mm unless otherwise indicated.

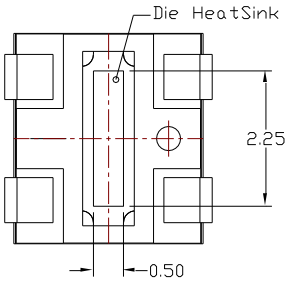
Top View

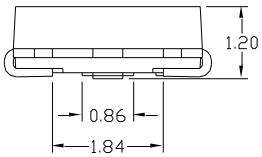




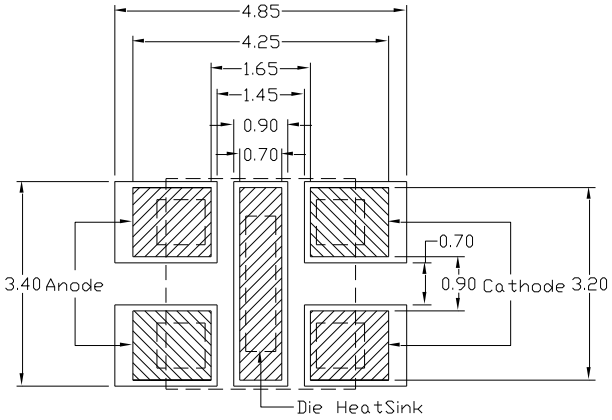

Top View

Bottom View

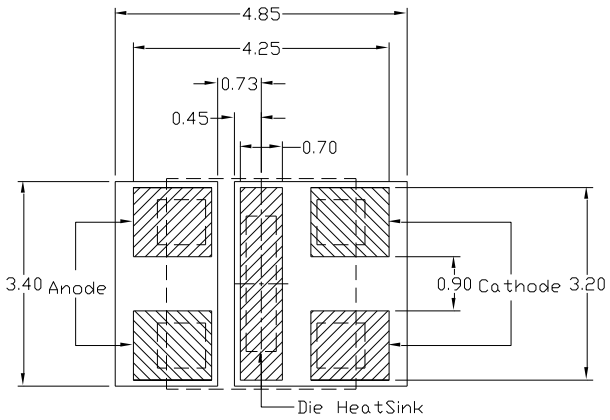


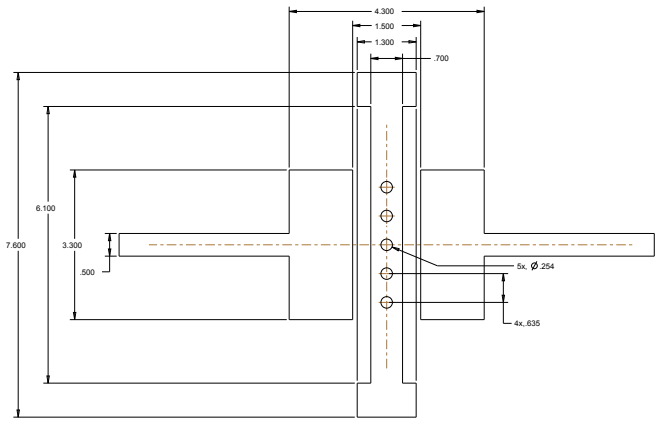

Side View




Recommended PCB Solder Pad




Alternative Solder Pad

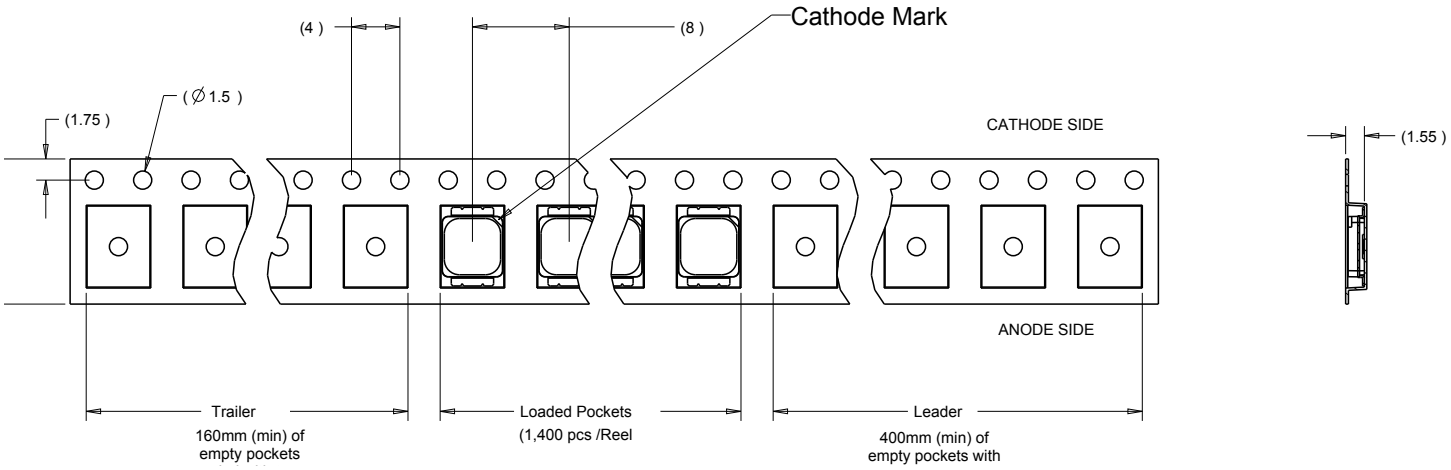


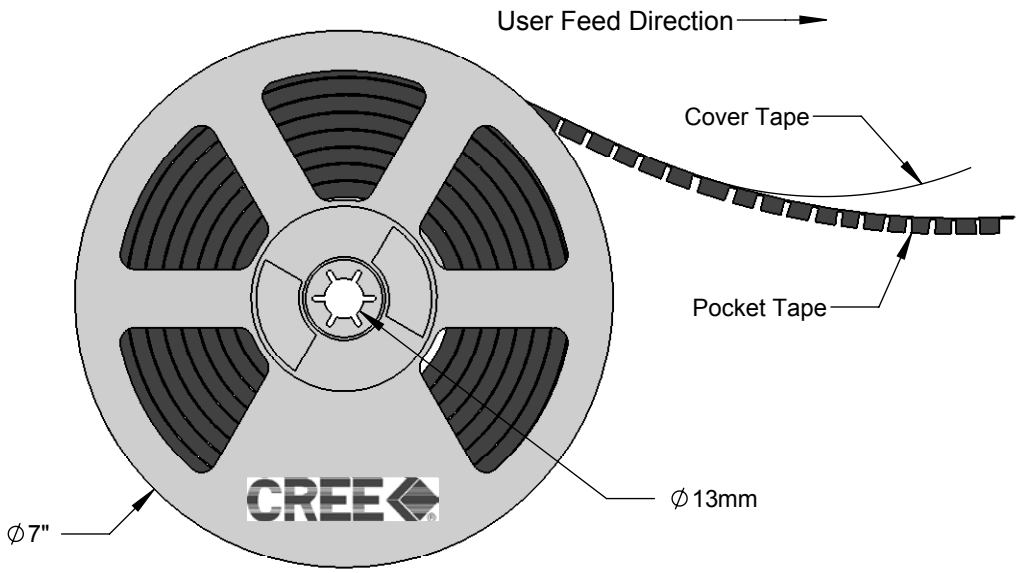

Recommended FR4 Solder Pad w/Thermal Vias

## TAPE AND REEL

All Cree carrier tapes conform to EIA-481D, Automated Component Handling Systems Standard.

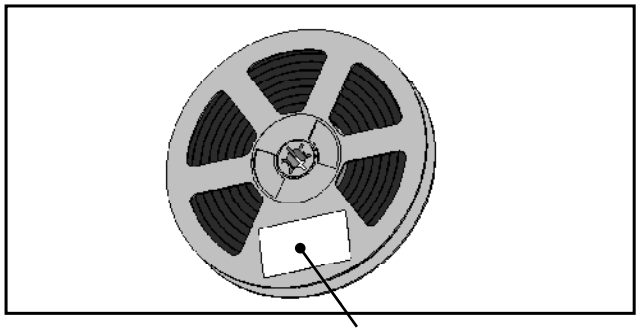
All dimensions in mm.



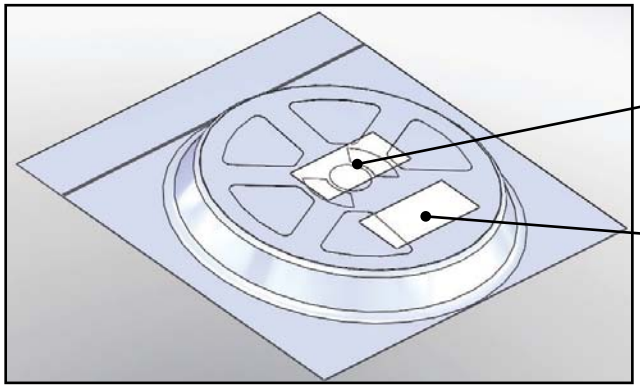



## PACKAGING

**Unpackaged Reel**




**Packaged Reel**




**Boxed Reel**