Cree® XLamp® XP-E2 LEDs

PRODUCT DESCRIPTION

The XLamp® XP-E2 LED builds on the unprecedented performance of the original XP-E by increasing lumen output up to 20% while providing a single die LED point source for precise optical control. The XP-E2 LED shares the same footprint as the original XP-E, providing a seamless upgrade path to more lumens and/or greater efficiency while shortening the design cycle for existing XP customers.

XLamp XP-E2 LEDs are the ideal choice for lighting applications where high light output and maximum efficacy are required, such as LED retrofit lamps, outdoor, portable, indoor directional, emergency vehicle or architectural.

FEATURES

- Available in white, outdoor white, 80-CRI, 85-CRI, 90-CRI white, royal blue, blue, green, PC amber, amber, red-orange, red, photo red & far red
- ANSI-compatible chromaticity bins
- White binned at 85 °C
- Maximum drive current: 1 A
- Low thermal resistance: as low as 5 °C/W
- Wide viewing angle: 110°-140°
- Unlimited floor life at ≤ 30 °C/85% RH
- Reflow solderable - JEDEC J-STD-020C compatible
- Electrically neutral thermal path
- RoHS and REACh compliant
- UL® recognized component (E349212)
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<th>Unit</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
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<td>Viewing angle (FWHM) - amber, red-orange, red, photo red</td>
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<td>Temperature coefficient of voltage - amber, red-orange, red</td>
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<td>ESD withstand voltage (HBM per Mil-Std-883D) - white, royal blue, blue, green</td>
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<td>DC forward current</td>
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<td>Reverse voltage</td>
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<td>Forward voltage (@ 1000 mA, 25 °C) - royal blue, blue</td>
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<td>3.5</td>
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<td>Forward voltage (@ 1000 mA, 25 °C) - PC amber</td>
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<tr>
<td>Forward voltage (@ 350 mA, 25 °C) - amber, red-orange, red</td>
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<tr>
<td>Forward voltage (@ 1000 mA, 25 °C) - amber, red-orange, red</td>
<td>V</td>
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<td>Forward voltage (@ 350 mA, 25 °C) - photo red</td>
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FLUX CHARACTERISTICS - WHITE (\(T_j = 85 \, ^\circ\)C)

The following tables provide order codes for XLamp XP-E2 white LEDs. For a complete description of the order code nomenclature, please see the Bin and Order Code Formats section (page 37). For definitions of the chromaticity kits, please see the Cree’s Standard Chromaticity Kits section (page 36).

<table>
<thead>
<tr>
<th>Chromaticity</th>
<th>Minimum Luminous Flux @ 350 mA</th>
<th>Calculated Minimum Luminous Flux (lm)** @ 85 °C</th>
<th>Order Codes</th>
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<td>CCT</td>
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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. See the Measurements section (page 39).
- Cree XLamp XP-E2 LED order codes specify only a minimum flux bin and not a maximum. Cree may ship reels in flux bins higher than the minimum specified by the order code without advance notice. Shipments will always adhere to the chromaticity bin restrictions specified by the order code.
- Flux values @ 25 °C are calculated and for reference only.
- **Calculated flux values at 700 mA and 1 A are for reference only.
### FLUX CHARACTERISTICS - WHITE (T<sub>j</sub> = 85 °C) - CONTINUED

<table>
<thead>
<tr>
<th>Chromaticity</th>
<th>Minimum Luminous Flux @ 350 mA (lm)</th>
<th>Calculated Minimum Luminous Flux (lm)** @ 85 °C</th>
<th>Order Codes</th>
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<tr>
<td></td>
<td>700 mA</td>
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<tr>
<td><strong>70 CRI Typical</strong></td>
<td><strong>75 CRI Typical</strong></td>
<td><strong>80 CRI Minimum</strong></td>
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<td><strong>Kit</strong></td>
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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. See the Measurements section (page 39).
- Cree XLamp XP-E2 LED order codes specify only a minimum flux bin and not a maximum. Cree may ship reels in flux bins higher than the minimum specified by the order code without advance notice. Shipments will always adhere to the chromaticity bin restrictions specified by the order code.
- Flux values @ 25 °C are calculated and for reference only.
- **Calculated flux values at 700 mA and 1 A are for reference only.**
## FLUX CHARACTERISTICS - WHITE (T<sub>j</sub> = 85 °C) - CONTINUED

<table>
<thead>
<tr>
<th>Chromaticity</th>
<th>Minimum Luminous Flux @ 350 mA</th>
<th>Calculated Minimum Luminous Flux (lm)** @ 85 °C**</th>
<th>Order Codes</th>
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- * Flux values at 25 °C are calculated and for reference only.
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<table>
<thead>
<tr>
<th>Chromaticity</th>
<th>Minimum Luminous Flux @ 350 mA</th>
<th>Calculated Minimum Luminous Flux (lm)** @ 85 °C</th>
<th>Order Codes</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Flux (lm) @ 85 °C</td>
<td>Flux (lm) @ 25 °C</td>
<td>700 mA</td>
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<tr>
<td>P2</td>
<td>67.2</td>
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<td>115</td>
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</table>

Notes:
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- Calculated flux values at 700 mA and 1 A are for reference only.
### FLUX CHARACTERISTICS - WHITE (T<sub>j</sub> = 85 °C) - CONTINUED

<table>
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<tr>
<th>Chromaticity</th>
<th>Minimum Luminous Flux @ 350 mA</th>
<th>Calculated Minimum Luminous Flux (lm)** @ 85 °C**</th>
<th>Order Codes</th>
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<tbody>
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<td></td>
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<td>Flux (lm) @ 25 °C</td>
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<tr>
<td>N4</td>
<td>62</td>
<td>72</td>
<td>106</td>
</tr>
</tbody>
</table>

| **E8** 2700 K |
| Q5 | 107 | 124 | 183 | 233 | XPEBWT-L1-0000-00DE8 |
| Q4 | 100 | 116 | 171 | 218 | XPEBWT-L1-0000-00CE8 |
| Q3 | 93.9 | 109 | 161 | 205 | XPEBWT-L1-0000-00BE8 |
| Q2 | 87.4 | 102 | 150 | 191 | XPEBWT-L1-0000-00AE8 |
| P4 | 80.6 | 93.6 | 138 | 176 | XPEBWT-L1-0000-009E8 |
| P3 | 73.9 | 85.8 | 127 | 161 | XPEBWT-P1-0000-008E8 |
| P2 | 67.2 | 78 | 115 | 147 | XPEBWT-P1-0000-007E8 |
| N4 | 62 | 72 | 106 | 135 | XPEBWT-P1-0000-006E8 |

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## FLUX CHARACTERISTICS - WHITE (T<sub>j</sub> = 85 °C) - CONTINUED

<table>
<thead>
<tr>
<th>Chromaticity</th>
<th>Minimum Luminous Flux @ 350 mA</th>
<th>Calculated Minimum Luminous Flux (lm)** @ 85 °C**</th>
<th>Order Codes</th>
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<td></td>
<td>Q2</td>
<td>87.4</td>
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<td>P4</td>
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<td>93.6</td>
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<td></td>
<td>P3</td>
<td>73.9</td>
<td>85.8</td>
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<td></td>
<td>N4</td>
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<td>72</td>
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</tbody>
</table>

Notes:  
- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and ±2 on CRI measurements. See the Measurements section (page 39).  
- Cree XLamp XP-E2 LED order codes specify only a minimum flux bin and not a maximum. Cree may ship reels in flux bins higher than the minimum specified by the order code without advance notice. Shipments will always adhere to the chromaticity bin restrictions specified by the order code.  
* Flux values @ 25 °C are calculated and for reference only.  
** Calculated flux values at 700 mA and 1 A are for reference only.
FLUX CHARACTERISTICS - COLOR (T\textsubscript{j} = 25 °C)

The following tables provide order codes for XLamp XP-E2 color LEDs. For a complete description of the order-code nomenclature, please see the Bin and Order Code Formats section (page 37).

<table>
<thead>
<tr>
<th>Color</th>
<th>Minimum Radiant Flux @ 350 mA</th>
<th>Calculated Minimum PPF (\mu mol/s)*</th>
<th>Dominant Wavelength (nm)</th>
<th>Order Codes</th>
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<td>455</td>
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Note:
- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements, ±2 on CRI measurements and ±1 on dominant wavelength measurements. See the Measurements section (page 39).
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- Calculated Photosynthetic Photon Flux (PPF) values are for reference only.
### FLUX CHARACTERISTICS - COLOR (T<sub>j</sub> = 25 °C) - CONTINUED

<table>
<thead>
<tr>
<th>Color</th>
<th>Minimum Luminous Flux (lm) @ 350 mA</th>
<th>Dominant Wavelength (nm)</th>
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<td>Minimum DWL (nm)</td>
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<td>B4 470</td>
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<table>
<thead>
<tr>
<th>Color</th>
<th>Minimum Luminous Flux (lm) @ 350 mA</th>
<th>Calculated Minimum PPF (µmol/s)*</th>
<th>Dominant Wavelength (nm)</th>
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<td>G3</td>
<td>525</td>
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## FLUX CHARACTERISTICS - COLOR \( (T_j = 25 \, ^\circ\text{C}) \) - CONTINUED

<table>
<thead>
<tr>
<th>Color</th>
<th>Minimum Luminous Flux (lm) @ 350 mA</th>
<th>Dominant Wavelength (nm)</th>
<th>Order Codes</th>
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<td>Group</td>
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</table>

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## FLUX CHARACTERISTICS - COLOR (T<sub>j</sub> = 25 °C) - CONTINUED

### Red-Orange

<table>
<thead>
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<th>Color</th>
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<th>Dominant Wavelength (nm)</th>
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<td>DWL (nm)</td>
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### Red

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<th>Minimum Luminous Flux (lm) @ 350 mA</th>
<th>Calculated Minimum PPF (µmol/s)*</th>
<th>Dominant Wavelength (nm)</th>
<th>Order Codes</th>
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Note:
- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements, ±2 on CRI measurements and ±1 on dominant wavelength measurements. See the Measurements section (page 39).
- Cree XLamp XP-E2 LED order codes specify only a minimum flux bin and not a maximum. Cree may ship reels in flux bins higher than the minimum specified by the order code without advance notice. Shipments will always adhere to the chromaticity bin restrictions specified by the order code.
* Calculated Photosynthetic Photon Flux (PPF) values are for reference only.
Note:
• Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and ±2 on CRI measurements. See the Measurements section (page 39).
• Cree XLamp XP-E2 LED order codes specify only a minimum flux bin and not a maximum. Cree may ship reels in flux bins higher than the minimum specified by the order code without advance notice. Shipments will always adhere to the chromaticity bin restrictions specified by the order code.
* Calculated Photosynthetic Photon Flux (PPF) and Far-Red Photon Flux (PF_{FR}) values are for reference only.
RELATIVE SPECTRAL POWER DISTRIBUTION

Cool White

Warm White

Royal Blue

Blue

Green

PC Amber

Amber

Red-Orange

Red

Photo Red

Far Red
RELATIVE FLUX VS. JUNCTION TEMPERATURE ($I_F = 350$ mA)

![Graph of Relative Flux Output vs. Junction Temperature for different colors: White, Royal Blue, Photo Red, Far Red, Blue, Green, PC Amber, Amber, Red-Orange, Red.](image-url)
**ELECTRICAL CHARACTERISTICS - WHITE (T_J = 85 °C)**

![Graph of White Electrical Characteristics](image)

**ELECTRICAL CHARACTERISTICS - COLOR (T_J = 25 °C)**

![Graph of Color Electrical Characteristics](image)
RELATIVE FLUX VS. CURRENT - WHITE ($T_j = 85 ^\circ C$)

![Graph showing relative flux vs. current for white LEDs at $T_j = 85 ^\circ C$.](image1)

RELATIVE FLUX VS. CURRENT - COLOR ($T_j = 25 ^\circ C$)

![Graph showing relative flux vs. current for various color LEDs at $T_j = 25 ^\circ C$.](image2)

![Graph showing relative flux vs. current for various color LEDs at $T_j = 25 ^\circ C$.](image3)
RELATIVE CHROMATICITY VS. CURRENT AND TEMPERATURE - WARM WHITE*

* Warm White XLamp XP-E2 LEDs have a typical CRI of 80.
TYPICAL SPATIAL DISTRIBUTION

Typical Spatial Radiation Pattern

Relative Luminous Intensity (%)

-90  -70  -50  -30  -10   10   30   50   70   90

Angle (°)

-90  -70  -50  -30  -10   10   30   50   70   90

Relative Luminous Intensity (%)

-90  -70  -50  -30  -10   10   30   50   70   90

Angle (°)

White

Royal Blue, Blue, Green

PC Amber

Amber, Red-Orange, Red

Photo Red

Far Red
THERMAL DESIGN

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 - CONTINUED

Photo Red

Ambient Temperature (°C)

Maximum Current (mA)

R<sub>j-a</sub> = 10°C/W

R<sub>j-a</sub> = 15°C/W

R<sub>j-a</sub> = 20°C/W

R<sub>j-a</sub> = 25°C/W

Far Red

Ambient Temperature (°C)

Maximum Current (mA)

R<sub>j-a</sub> = 10°C/W

R<sub>j-a</sub> = 15°C/W

R<sub>j-a</sub> = 20°C/W

R<sub>j-a</sub> = 25°C/W
PERFORMANCE GROUPS - LUMINOUS FLUX

XLamp XP-E2 LEDs (except royal blue, photo red and far red) are tested for luminous flux and placed into one of the following luminous-flux groups:

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<tr>
<th>Group Code</th>
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<th>Maximum Luminous Flux (lm) @ 350 mA</th>
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**PERFORMANCE GROUPS - RADIANT FLUX (T_j = 25 °C)**

XLamp XP-E2 royal blue and photo red LEDs are tested for radiant flux and placed into one the following bins:

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<th>Group</th>
<th>Minimum Radiant Flux (mW) @ 350 mA</th>
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XLamp XP-E2 far red LEDs are tested for radiant flux and sorted into one of the following radiant-flux bins:

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**PERFORMANCE GROUPS - CHROMATICITY**

White XLamp XP-E2 LEDs are tested for chromaticity and placed into one of the regions defined by the bounding coordinates on the following pages.

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<th>y</th>
<th>Region</th>
<th>x</th>
<th>y</th>
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<td>0.488</td>
<td>0.397</td>
<td>AA2</td>
<td>0.494</td>
<td>0.416</td>
<td>AA3</td>
<td>0.501</td>
<td>0.424</td>
<td>AA4</td>
<td>0.487</td>
<td>0.392</td>
</tr>
<tr>
<td></td>
<td>0.488</td>
<td>0.416</td>
<td></td>
<td>0.506</td>
<td>0.416</td>
<td></td>
<td>0.506</td>
<td>0.415</td>
<td></td>
<td>0.492</td>
<td>0.420</td>
</tr>
<tr>
<td>8B1</td>
<td>0.494</td>
<td>0.416</td>
<td>AB2</td>
<td>0.500</td>
<td>0.425</td>
<td>AB3</td>
<td>0.506</td>
<td>0.424</td>
<td>AB4</td>
<td>0.500</td>
<td>0.416</td>
</tr>
<tr>
<td></td>
<td>0.500</td>
<td>0.425</td>
<td></td>
<td>0.500</td>
<td>0.425</td>
<td></td>
<td>0.506</td>
<td>0.424</td>
<td></td>
<td>0.506</td>
<td>0.416</td>
</tr>
<tr>
<td>8C1</td>
<td>0.500</td>
<td>0.425</td>
<td>AB3</td>
<td>0.513</td>
<td>0.438</td>
<td>AC1</td>
<td>0.506</td>
<td>0.418</td>
<td>AC2</td>
<td>0.512</td>
<td>0.425</td>
</tr>
<tr>
<td></td>
<td>0.513</td>
<td>0.438</td>
<td></td>
<td>0.513</td>
<td>0.438</td>
<td></td>
<td>0.507</td>
<td>0.430</td>
<td></td>
<td>0.512</td>
<td>0.425</td>
</tr>
<tr>
<td>9A1</td>
<td>0.506</td>
<td>0.418</td>
<td>AB4</td>
<td>0.519</td>
<td>0.432</td>
<td>AC3</td>
<td>0.525</td>
<td>0.434</td>
<td>AC4</td>
<td>0.519</td>
<td>0.425</td>
</tr>
<tr>
<td></td>
<td>0.506</td>
<td>0.418</td>
<td></td>
<td>0.513</td>
<td>0.438</td>
<td></td>
<td>0.528</td>
<td>0.434</td>
<td></td>
<td>0.525</td>
<td>0.428</td>
</tr>
<tr>
<td>8D1</td>
<td>0.525</td>
<td>0.434</td>
<td>AD2</td>
<td>0.505</td>
<td>0.406</td>
<td>AD3</td>
<td>0.518</td>
<td>0.415</td>
<td>AD4</td>
<td>0.499</td>
<td>0.396</td>
</tr>
<tr>
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<td>0.525</td>
<td>0.434</td>
<td></td>
<td>0.509</td>
<td>0.406</td>
<td></td>
<td>0.512</td>
<td>0.415</td>
<td></td>
<td>0.505</td>
<td>0.406</td>
</tr>
<tr>
<td>9A1</td>
<td>0.525</td>
<td>0.434</td>
<td>AD3</td>
<td>0.518</td>
<td>0.415</td>
<td></td>
<td>0.518</td>
<td>0.415</td>
<td></td>
<td>0.505</td>
<td>0.406</td>
</tr>
<tr>
<td></td>
<td>0.525</td>
<td>0.434</td>
<td></td>
<td>0.518</td>
<td>0.415</td>
<td></td>
<td>0.518</td>
<td>0.415</td>
<td></td>
<td>0.505</td>
<td>0.406</td>
</tr>
<tr>
<td>9A2</td>
<td>0.518</td>
<td>0.415</td>
<td></td>
<td>0.518</td>
<td>0.415</td>
<td></td>
<td>0.518</td>
<td>0.415</td>
<td></td>
<td>0.505</td>
<td>0.406</td>
</tr>
</tbody>
</table>

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PERFORMANCE GROUPS - CHROMATICITY (CONTINUED)

XLamp XP-E2 PC amber LEDs are placed into the region defined by the following bounding coordinates.

<table>
<thead>
<tr>
<th>Region</th>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y2</td>
<td>0.5469</td>
<td>0.4249</td>
</tr>
<tr>
<td></td>
<td>0.5700</td>
<td>0.4100</td>
</tr>
<tr>
<td></td>
<td>0.5900</td>
<td>0.4100</td>
</tr>
<tr>
<td></td>
<td>0.5610</td>
<td>0.4390</td>
</tr>
</tbody>
</table>

PERFORMANCE GROUPS - DOMINANT WAVELENGTH

Color XLamp XP-E2 LEDs are tested for dominant wavelength (DWL) and sorted into one of the DWL bins defined below.

<table>
<thead>
<tr>
<th>Color</th>
<th>DWL Group</th>
<th>Minimum DWL (nm) @ 350 mA</th>
<th>Maximum DWL (nm) @ 350 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royal Blue</td>
<td>D3</td>
<td>450</td>
<td>455</td>
</tr>
<tr>
<td></td>
<td>D4</td>
<td>455</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>D5</td>
<td>460</td>
<td>465</td>
</tr>
<tr>
<td>Blue</td>
<td>B3</td>
<td>465</td>
<td>470</td>
</tr>
<tr>
<td></td>
<td>B4</td>
<td>470</td>
<td>475</td>
</tr>
<tr>
<td></td>
<td>B5</td>
<td>475</td>
<td>480</td>
</tr>
<tr>
<td></td>
<td>B6</td>
<td>480</td>
<td>485</td>
</tr>
<tr>
<td>Green</td>
<td>G2</td>
<td>520</td>
<td>525</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>525</td>
<td>530</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>530</td>
<td>535</td>
</tr>
<tr>
<td>Amber</td>
<td>A2</td>
<td>585</td>
<td>590</td>
</tr>
<tr>
<td></td>
<td>A3</td>
<td>590</td>
<td>595</td>
</tr>
<tr>
<td>Red-Orange</td>
<td>O3</td>
<td>610</td>
<td>615</td>
</tr>
<tr>
<td></td>
<td>O4</td>
<td>615</td>
<td>620</td>
</tr>
<tr>
<td>Red</td>
<td>R2</td>
<td>620</td>
<td>625</td>
</tr>
<tr>
<td></td>
<td>R3</td>
<td>625</td>
<td>630</td>
</tr>
</tbody>
</table>
PERFORMANCE GROUPS - PEAK WAVELENGTH

Photo red and far red XLamp XP-E2 LEDs are tested for peak wavelength (PWL) and sorted into one of the PWL bins defined below.

<table>
<thead>
<tr>
<th>Color</th>
<th>PWL Group</th>
<th>Minimum PWL (nm) @ 350 mA</th>
<th>Maximum PWL (nm) @ 350 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo Red</td>
<td>P2</td>
<td>650</td>
<td>655</td>
</tr>
<tr>
<td></td>
<td>P3</td>
<td>655</td>
<td>660</td>
</tr>
<tr>
<td></td>
<td>P4</td>
<td>660</td>
<td>665</td>
</tr>
<tr>
<td></td>
<td>P5</td>
<td>665</td>
<td>670</td>
</tr>
<tr>
<td>Far Red</td>
<td>F2</td>
<td>720</td>
<td>725</td>
</tr>
<tr>
<td></td>
<td>F3</td>
<td>725</td>
<td>730</td>
</tr>
<tr>
<td></td>
<td>F4</td>
<td>730</td>
<td>735</td>
</tr>
<tr>
<td></td>
<td>F5</td>
<td>735</td>
<td>740</td>
</tr>
</tbody>
</table>

PERFORMANCE GROUPS - FORWARD VOLTAGE

Amber, red-orange, red, photo red and far red XLamp XP-E2 LEDs are tested for forward voltage and sorted into one of the forward voltage bins defined below.

<table>
<thead>
<tr>
<th>Forward Voltage Group</th>
<th>Minimum Forward Voltage (V) @ 350 mA</th>
<th>Maximum Forward Voltage (V) @ 350 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.5</td>
<td>1.75</td>
</tr>
<tr>
<td>B</td>
<td>1.75</td>
<td>2.0</td>
</tr>
<tr>
<td>C</td>
<td>2.0</td>
<td>2.25</td>
</tr>
<tr>
<td>D</td>
<td>2.25</td>
<td>2.5</td>
</tr>
<tr>
<td>E</td>
<td>2.5</td>
<td>2.75</td>
</tr>
<tr>
<td>F</td>
<td>2.75</td>
<td>3.0</td>
</tr>
<tr>
<td>G</td>
<td>3.0</td>
<td>3.25</td>
</tr>
<tr>
<td>H</td>
<td>3.25</td>
<td>3.5</td>
</tr>
<tr>
<td>J</td>
<td>3.5</td>
<td>3.75</td>
</tr>
</tbody>
</table>
CREE’S STANDARD CHROMATICITY REGIONS PLOTTED ON THE 1931 CIE CURVE

ANSI Cool White

ANSI Neutral White and ANSI Warm White
CREE’S STANDARD WARM AND NEUTRAL WHITE KITS PLOTTED ON ANSI STANDARD CHROMATICITY REGIONS

CCx

CCy

ANSI C78.377A

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CREE’S STANDARD WARM AND NEUTRAL WHITE KITS PLOTTED ON ANSI STANDARD CHROMATICITY REGIONS - CONTINUED

![Diagram of ANSI standard chromaticity regions showing CREE's standard warm and neutral white kits plotted on the 1931 CIE curve.]

CREE’S PC AMBER KIT PLOTTED ON THE 1931 CIE CURVE

![Diagram of 1931 CIE curve showing CREE's PC amber kit plotted within the Y2 region.]
CREE’S 2200 K CCT WHITE KITS PLOTTED ON ANSI STANDARD CHROMATICITY REGIONS
## CREE’S STANDARD CHROMATICITY KITS

The following table provides the chromaticity bins associated with chromaticity kits.

<table>
<thead>
<tr>
<th>Color</th>
<th>CCT</th>
<th>Kit</th>
<th>Chromaticity Bins</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cool White</td>
</tr>
<tr>
<td></td>
<td>6200</td>
<td>S1</td>
<td>0A, 0B, 0C, 0D, 0R, 0S, 0T, 0U, 1A, 1B, 1C, 1D, 1R, 1S, 1T, 1U, 2A, 2B, 2C, 2D, 2R, 2S, 2T, 2U, 3A, 3B, 3R, 3S</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>S3</td>
<td>1A, 1B, 1C, 1D, 1R, 1S, 1T, 1U, 2A, 2B, 2C, 2D, 2R, 2S, 2T, 3A, 3B, 3S</td>
</tr>
<tr>
<td></td>
<td>6200</td>
<td>S0</td>
<td>1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D</td>
</tr>
<tr>
<td></td>
<td>6500</td>
<td>E1</td>
<td>1A, 1B, 1C, 1D</td>
</tr>
<tr>
<td></td>
<td>5700</td>
<td>E2</td>
<td>2A, 2B, 2C, 2D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Neutral White</td>
</tr>
<tr>
<td></td>
<td>5000</td>
<td>E3</td>
<td>3A, 3B, 3C, 3D</td>
</tr>
<tr>
<td></td>
<td>4750</td>
<td>F4</td>
<td>3C, 3D, 4A, 4B</td>
</tr>
<tr>
<td></td>
<td>4500</td>
<td>E4</td>
<td>4A, 4B, 4C, 4D</td>
</tr>
<tr>
<td></td>
<td>4250</td>
<td>F5</td>
<td>4C, 4D, 5A1, 5A2, 5A3, 5A4, 5B1, 5B2, 5B3, 5B4</td>
</tr>
<tr>
<td></td>
<td>4000</td>
<td>E5</td>
<td>5A1, 5A2, 5A3, 5A4, 5B1, 5B2, 5B3, 5B4, 5C1, 5C2, 5C3, 5C4, 5D1, 5D2, 5D3, 5D4</td>
</tr>
<tr>
<td></td>
<td>4000</td>
<td>Z5</td>
<td>5A3, 5B4, 5C1, 5D2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Warm White</td>
</tr>
<tr>
<td></td>
<td>3750</td>
<td>F6</td>
<td>5C1, 5C2, 5C3, 5C4, 5D1, 5D2, 5D3, 5D4, 6A1, 6A2, 6A3, 6A4, 6B1, 6B2, 6B3, 6B4</td>
</tr>
<tr>
<td></td>
<td>3500</td>
<td>E6</td>
<td>6A1, 6A2, 6A3, 6A4, 6B1, 6B2, 6B3, 6B4, 6C1, 6C2, 6C3, 6C4, 6D1, 6D2, 6D3, 6D4</td>
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<tr>
<td></td>
<td>3500</td>
<td>Z6</td>
<td>6A3, 6B4, 6C1, 6D2</td>
</tr>
<tr>
<td></td>
<td>3250</td>
<td>F7</td>
<td>6C1, 6C2, 6C3, 6C4, 6D1, 6D2, 6D3, 6D4, 7A1, 7A2, 7A3, 7A4, 7B1, 7B2, 7B3, 7B4</td>
</tr>
<tr>
<td></td>
<td>3000</td>
<td>E7</td>
<td>7A1, 7A2, 7A3, 7A4, 7B1, 7B2, 7B3, 7B4, 7C1, 7C2, 7C3, 7C4, 7D1, 7D2, 7D3, 7D4</td>
</tr>
<tr>
<td></td>
<td>3000</td>
<td>Z7</td>
<td>7A3, 7B4, 7C1, 7D2</td>
</tr>
<tr>
<td></td>
<td>2850</td>
<td>F8</td>
<td>7C1, 7C2, 7C3, 7C4, 7D1, 7D2, 7D3, 7D4, 8A1, 8A2, 8A3, 8A4, 8B1, 8B2, 8B3, 8B4</td>
</tr>
<tr>
<td></td>
<td>2700</td>
<td>E8</td>
<td>8A1, 8A2, 8A3, 8A4, 8B1, 8B2, 8B3, 8B4, 8C1, 8C2, 8C3, 8C4, 8D1, 8D2, 8D3, 8D4</td>
</tr>
<tr>
<td></td>
<td>2700</td>
<td>Z8</td>
<td>8A3, 8B4, 8C1, 8D2</td>
</tr>
<tr>
<td></td>
<td>2200</td>
<td>EA</td>
<td>AA1, AA2, AA3, AA4, AB1, AB2, AB3, AB4, AC1, AC2, AC3, AC4, AD1, AD2, AD3, AD4</td>
</tr>
<tr>
<td></td>
<td>2200</td>
<td>ZA</td>
<td>AA3, AB4, AC1, AD2</td>
</tr>
</tbody>
</table>
BIN AND ORDER CODE FORMATS

XP-E2 bin codes and order codes are configured in the following manner:

**Order Code**

- **Series**
  - XPE = XP-E

- **Color specification**
  - 01 = Outdoor White
  - L1 = Standard CRI
  - H1 = 80 CRI minimum
  - P1 = 85 CRI minimum
  - U1 = 90 CRI minimum

- **Kit Number**

- **Internal code**

- **Color**
  - BWT = Gen 2 White
  - BRY = Gen 2 Royal Blue
  - BBL = Gen 2 Blue
  - BGR = Gen 2 Green
  - BPA = Gen 2 PC Amber
  - BAM = Gen 2 Amber
  - BRO = Gen 2 Red-Orange
  - BRD = Gen 2 Red
  - BPR = Gen 2 Photo Red
  - BFR = Gen 2 Far Red

**Bin Code**

- **Series**
  - XPE = XP-E

- **Color specification**
  - 01 = Outdoor White
  - L1 = Standard CRI
  - H1 = 80 CRI minimum
  - P1 = 85 CRI minimum
  - U1 = 90 CRI minimum

- **Luminous or radiant flux group**

- **Internal code**

- **Voltage performance group**
  - (amber, red-orange, red)

- **Chromaticity bin or dominant-wavelength group**

- **Color**
  - BWT = Gen 2 White
  - BRY = Gen 2 Royal Blue
  - BBL = Gen 2 Blue
  - BGR = Gen 2 Green
  - BPA = Gen 2 PC Amber
  - BAM = Gen 2 Amber
  - BRO = Gen 2 Red-Orange
  - BRD = Gen 2 Red
  - BPR = Gen 2 Photo Red
  - BFR = Gen 2 Far Red
REFLOW SOLDERING CHARACTERISTICS

In testing, Cree has found XLamp XP-E2 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, and therefore it is the lamp or luminaire manufacturer’s responsibility to determine applicable soldering requirements.

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

<table>
<thead>
<tr>
<th>Profile Feature</th>
<th>Lead-Free Solder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Ramp-Up Rate (Ts_max to Tp)</td>
<td>1.2 °C/second</td>
</tr>
<tr>
<td>Preheat: Temperature Min (Ts_min)</td>
<td>120 °C</td>
</tr>
<tr>
<td>Preheat: Temperature Max (Ts_max)</td>
<td>170 °C</td>
</tr>
<tr>
<td>Preheat: Time (ts_min to ts_max)</td>
<td>65-150 seconds</td>
</tr>
<tr>
<td>Time Maintained Above: Temperature (T_L)</td>
<td>217 °C</td>
</tr>
<tr>
<td>Time Maintained Above: Time (t_L)</td>
<td>45-90 seconds</td>
</tr>
<tr>
<td>Peak/Classification Temperature (Tp)</td>
<td>235 - 245 °C</td>
</tr>
<tr>
<td>Time Within 5 °C of Actual Peak Temperature (tp)</td>
<td>20-40 seconds</td>
</tr>
<tr>
<td>Ramp-Down Rate</td>
<td>1 - 6 °C/second</td>
</tr>
<tr>
<td>Time 25 °C to Peak Temperature</td>
<td>4 minutes max.</td>
</tr>
</tbody>
</table>

Note: All temperatures refer to topside of the package, measured on the package body surface.
NOTES

Measurements
The luminous flux, radiant power, chromaticity, forward voltage and CRI measurements in this document are binning specifications only and solely represent product measurements as of the date of shipment. These measurements will change over time based on a number of factors that are not within Cree's control and are not intended or provided as operational specifications for the products. Calculated values are provided for informational purposes only and are not intended or provided as specifications.

Pre-Release Qualification Testing
Please read the LED Reliability Overview for details of the qualification process Cree applies to ensure long-term reliability for XLamp LEDs and details of Cree's pre-release qualification testing for XLamp LEDs.

Lumen Maintenance
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.

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

Moisture Sensitivity
Cree recommends keeping XLamp LEDs in the provided, resealable moisture-barrier packaging (MBP) until immediately prior to soldering. Unopened MBPs that contain XLamp LEDs do not need special storage for moisture sensitivity.

Once the MBP is opened, XLamp XP-E2 LEDs may be stored as MSL 1 per JEDEC J-STD-033, meaning they have unlimited floor life in conditions of ≤ 30 °C/85% relative humidity (RH). Regardless of the storage condition, Cree recommends sealing any unsoldered LEDs in the original MBP.

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 implemented January 2, 2013. RoHS Declarations for this product can be obtained from your Cree representative or from the Product Ecology section of the Cree website.

REACH Compliance
REACH substances of very high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice 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 SVHC Declaration. REACH banned substance information (REACH Article 67) is also available upon request.
NOTES - CONTINUED

UL® Recognized Component
This product meets the requirements to be considered a UL Recognized Component with 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
WARNING: Do not look at an exposed lamp in operation. Eye injury can result. For more information about LEDs and eye safety, please refer to the LED Eye Safety application note.
MECHANICAL DIMENSIONS

Thermal vias, if present, are not shown on these drawings.

All measurements are ±13 mm unless otherwise indicated.
TAPE AND REEL

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

All dimensions in mm.

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<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ao</td>
<td>3.70  +/- 0.1</td>
</tr>
<tr>
<td>Bo</td>
<td>3.70  +/- 0.1</td>
</tr>
<tr>
<td>Ko</td>
<td>2.40  +/- 0.0/0.1</td>
</tr>
<tr>
<td>P</td>
<td>5.50  +/- 0.05</td>
</tr>
<tr>
<td>P-1</td>
<td>6.00  +/- 0.1</td>
</tr>
<tr>
<td>W</td>
<td>12.00 +/- 0.3/0.1</td>
</tr>
</tbody>
</table>

(i) Measured from centerline of sprocket hole to centerline of pocket.
(ii) Cumulative tolerance of 10 sprocket holes is ±0.20.
(iii) Measured from centerline of sprocket hole to centerline of pocket.
(iv) Other material available.

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SECTION Y-Y

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SECTION X-X

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END

Trailers 160mm (min) of empty pockets sealed with tape (20 pockets min.)

START

Loaded Pockets (1,000 Lamps)

Leader 400mm (min) of empty pockets with at least 100mm sealed by tape (50 empty pockets min.)
PACKAGING

Unpackaged Reel

Label with Cree Bin Code, Quantity, Reel ID

Packaged Reel

Label with Cree Order Code, Quantity, Reel ID, PO #
Label with Cree Bin Code, Quantity, Reel ID

Boxed Reel

Label with Cree Order Code, Quantity, Reel ID, PO #
Label with Cree Bin Code, Quantity, Reel ID
Patent Label (on bottom of box)