Cree® XLamp® XM-L Color LEDs

**PRODUCT DESCRIPTION**

The XLamp XM-L Color LED is a multi-color LED that provides high lumen output in a small package. Compared to discrete LEDs, XLamp XM-L Color LEDs reduce the distance between LED die, creating a small optical source for excellent optical control and efficient color mixing. XLamp XM-L Color LEDs can reduce LED system complexity by reducing the number of components required.

Cree XLamp XM-L Color LEDs bring high performance and quality of light to a wide range of lighting applications, including color-changing lighting, stage lighting, architectural lighting, indoor directional lighting, and entertainment lighting.

**FEATURES**

- Available in red, green, blue and white in a single 5 mm x 5 mm package
- Maximum drive current per LED die: 1 A
- Individually addressable LEDs
- Reflow solderable – JEDEC J-STD-020
- Electrically neutral thermal path

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**CHARACTERISTICS - COMPLETE PACKAGE**

The following table lists the product characteristics for the XLamp XM-L Color LED package, measured with all LED dies on simultaneously and each LED die connected to independent drive circuits at 350 mA.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Unit</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal resistance, junction to solder point</td>
<td>°C/W</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viewing angle (FWHM)</td>
<td>degrees (°)</td>
<td>130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESD withstand voltage (HBM per Mil-Std-883D)</td>
<td>V</td>
<td></td>
<td>8000</td>
<td></td>
</tr>
<tr>
<td>LED junction temperature</td>
<td>°C</td>
<td></td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

**CHARACTERISTICS - PER LED DIE**

The following table lists the product characteristics for each LED die within the XLamp XM-L Color LED package.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Unit</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature coefficient of voltage - red</td>
<td>mV/°C</td>
<td>-1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient of voltage - green</td>
<td>mV/°C</td>
<td>-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature coefficient of voltage - blue, white</td>
<td>mV/°C</td>
<td>-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC forward current - red, green, blue, white</td>
<td>mA</td>
<td></td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Forward voltage (@ 350 mA, 25 °C) - red</td>
<td>V</td>
<td>2.25</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Forward voltage (@ 350 mA, 25 °C) - green</td>
<td>V</td>
<td>3.3</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>Forward voltage (@ 350 mA, 25 °C) - blue, white</td>
<td>V</td>
<td>3.1</td>
<td>3.7</td>
<td></td>
</tr>
</tbody>
</table>
FLUX CHARACTERISTICS, \( (T_s = 25 ^\circ C) \)

The following tables provide several base order codes for XM-L Color LEDs. For a complete description of the order code nomenclature, please refer to the Bin and Order Code Formats section (page 6).

<table>
<thead>
<tr>
<th>Color</th>
<th>CCT / Dominant Wavelength Range</th>
<th>Base order codes</th>
<th>Order Code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td>Group</td>
</tr>
<tr>
<td>Color +</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cool White</td>
<td>Red</td>
<td>620 nm</td>
<td>630 nm</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>520 nm</td>
<td>535 nm</td>
</tr>
<tr>
<td></td>
<td>Blue</td>
<td>450 nm</td>
<td>465 nm</td>
</tr>
<tr>
<td></td>
<td>Cool White</td>
<td>5700 K</td>
<td>8000 K</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>620 nm</td>
<td>630 nm</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>520 nm</td>
<td>535 nm</td>
</tr>
<tr>
<td></td>
<td>Blue</td>
<td>450 nm</td>
<td>465 nm</td>
</tr>
<tr>
<td></td>
<td>Neutral White</td>
<td>3700 K</td>
<td>4300 K</td>
</tr>
</tbody>
</table>

Notes:
- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity \((CCx, CCy)\) measurements and ± 1 nm on dominant wavelength measurements.
- Flux and chromaticity are measured with each LED die connected to independent drive circuits at 350 mA. The flux and chromaticity of each LED die within the XLamp XM-L Color LED package are measured individually.

RELATIVE SPECTRAL POWER DISTRIBUTION \( (I_s = 350 \text{ mA PER LED DIE}, 25 ^\circ C) \)

The following graph represents typical spectral output of the XLamp XM-L Color LED with each LED die on independently.
**RELATIVE FLUX VS JUNCTION TEMPERATURE (I_f = 350 mA)**

The following graph represents typical performance of each LED die in the XLamp XM-L Color LED.

**ELECTRICAL CHARACTERISTICS (T_j = 25 °C)**

The following graph represents typical performance of each LED die in the XLamp XM-L Color LED.
RELATIVE FLUX VS. CURRENT (T_J = 25 °C)

The following graph represents typical performance of each LED die in the XLamp XM-L Color LED.

![Relative Flux vs. Current Graph](image)

TYPICAL SPATIAL DISTRIBUTION

The following graph represents typical spectral output of the XLamp XM-L Color LED with all four LEDs on simultaneously.

![Typical Spatial Distribution Graph](image)
BIN AND ORDER-CODE FORMATS

Bin codes and order codes are configured in the following manner:

Order Code

Bin Code

PERFORMANCE GROUPS – BRIGHTNESS

Each LED die in the XLamp XM-L Color LED is tested individually for luminous flux and placed into one of the following luminous-flux groups.

<table>
<thead>
<tr>
<th>Color</th>
<th>Group Code</th>
<th>Min. Luminous Flux (lm) @ 350 mA</th>
<th>Max. Luminous Flux (lm) @ 350 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>M</td>
<td>45.7</td>
<td>87.4</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>87.4</td>
<td>114</td>
</tr>
<tr>
<td>Green</td>
<td>N</td>
<td>87.4</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>114</td>
<td>148</td>
</tr>
<tr>
<td>Blue</td>
<td>F</td>
<td>13.9</td>
<td>39.8</td>
</tr>
<tr>
<td>White</td>
<td>2</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>120</td>
<td>140</td>
</tr>
</tbody>
</table>

- Flux and chromaticity are measured with each LED die connected to independent drive circuits at 350 mA.
**PERFORMANCE GROUPS – CHROMATICITY (I_f = 350 mA PER LED DIE)**

The white LED die in the XLamp XM-L Color LED is individually tested for chromaticity at 350 mA and placed into one of the regions defined by the bounding coordinates shown below.

<table>
<thead>
<tr>
<th>Region</th>
<th>x</th>
<th>y</th>
<th>Region</th>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>WM</td>
<td>.295</td>
<td>.297</td>
<td>WC</td>
<td>.316</td>
<td>.332</td>
</tr>
<tr>
<td></td>
<td>.308</td>
<td>.311</td>
<td></td>
<td>.317</td>
<td>.319</td>
</tr>
<tr>
<td></td>
<td>.310</td>
<td>.300</td>
<td></td>
<td>.308</td>
<td>.311</td>
</tr>
<tr>
<td></td>
<td>.298</td>
<td>.288</td>
<td></td>
<td>.306</td>
<td>.322</td>
</tr>
<tr>
<td>WB</td>
<td>.306</td>
<td>.322</td>
<td>WF</td>
<td>.314</td>
<td>.355</td>
</tr>
<tr>
<td></td>
<td>.308</td>
<td>.311</td>
<td></td>
<td>.316</td>
<td>.332</td>
</tr>
<tr>
<td></td>
<td>.295</td>
<td>.297</td>
<td></td>
<td>.306</td>
<td>.322</td>
</tr>
<tr>
<td></td>
<td>.292</td>
<td>.306</td>
<td></td>
<td>.301</td>
<td>.342</td>
</tr>
<tr>
<td>WE</td>
<td>.301</td>
<td>.342</td>
<td>WD</td>
<td>.329</td>
<td>.345</td>
</tr>
<tr>
<td></td>
<td>.306</td>
<td>.322</td>
<td></td>
<td>.329</td>
<td>.330</td>
</tr>
<tr>
<td></td>
<td>.292</td>
<td>.306</td>
<td></td>
<td>.317</td>
<td>.319</td>
</tr>
<tr>
<td></td>
<td>.287</td>
<td>.321</td>
<td></td>
<td>.316</td>
<td>.332</td>
</tr>
<tr>
<td>WN</td>
<td>.308</td>
<td>.311</td>
<td>WG</td>
<td>.329</td>
<td>.369</td>
</tr>
<tr>
<td></td>
<td>.317</td>
<td>.319</td>
<td></td>
<td>.329</td>
<td>.345</td>
</tr>
<tr>
<td></td>
<td>.318</td>
<td>.308</td>
<td></td>
<td>.316</td>
<td>.332</td>
</tr>
<tr>
<td></td>
<td>.310</td>
<td>.300</td>
<td></td>
<td>.314</td>
<td>.355</td>
</tr>
</tbody>
</table>

**PERFORMANCE GROUPS – DOMINANT WAVELENGTH**

The red, green and blue LED dies in the XLamp XM-L Color LED are tested individually 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>Min. DWL @ 350 mA</th>
<th>Max. DWL @ 350 mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>K</td>
<td>450</td>
<td>455</td>
</tr>
<tr>
<td></td>
<td>L</td>
<td>455</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>460</td>
<td>465</td>
</tr>
<tr>
<td>Green</td>
<td>2</td>
<td>520</td>
<td>525</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>525</td>
<td>530</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>530</td>
<td>535</td>
</tr>
<tr>
<td>Red</td>
<td>A</td>
<td>620</td>
<td>630</td>
</tr>
</tbody>
</table>
STANDARD ORDER CODES AND BINS

The following tables list standard kit numbers and performance bins. Kit numbers completely describe an order code’s color or chromaticity bins and luminous flux range.

<table>
<thead>
<tr>
<th>Color</th>
<th>Minimum Luminous Flux (lm) @ 350 mA*</th>
<th>DWL / Chromaticity Bins</th>
<th>Kit Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>M 45.7</td>
<td>A</td>
<td>00C3AAA1</td>
</tr>
<tr>
<td>Green</td>
<td>N 87.4</td>
<td>2, 3, 4</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>F 13.9</td>
<td>K, L, M</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>3 100</td>
<td>WC, WD, WF, WG, WB, WE, WM, WN</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>M 45.7</td>
<td>A</td>
<td>00C2AAAB1</td>
</tr>
<tr>
<td>Green</td>
<td>N 87.4</td>
<td>2, 3, 4</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>F 13.9</td>
<td>K, L, M</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>2 80</td>
<td>5A, 5B, 5C, 5D</td>
<td></td>
</tr>
</tbody>
</table>

For other flux and chromaticity combinations, contact Cree or an authorized distributor.

* Cree XLamp XM-L Color 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 or DWL bin restrictions specified by the order code.
REFLOW SOLDERING CHARACTERISTICS

In testing, Cree has found XLamp XM-L Color 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 solder paste used.

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

### Profile Feature

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

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

All measurements are ±.13 mm unless otherwise indicated.

TOP VIEW

SIDE VIEW

BOTTOM VIEW

Anode

COLOR
D1: RED
D2: GREEN
D3: BLUE
D4: WHITE

Recommended PCB Solder Pad

Recommended Stencil Pattern
(Shaded Area Is Open)
TAPE AND REEL

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

All dimensions in mm.
PACKAGING

Unpackaged Reel

Label with Cree Bin Code, Qty, Reel ID

Packaged Reel

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

Boxed Reel

Label with Cree Order Code, Qty, Reel ID, PO #
Label with Cree Bin Code, Qty, Reel ID
Patent Label