Cree® XLamp® ML-C LEDs

PRODUCT DESCRIPTION

The Cree XLamp ML-C LED brings lighting-class reliability and performance to 1/3-watt LEDs. The XLamp ML-C 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-C LED continues Cree's history of segment-focused product innovation in LEDs for lighting applications.

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

FEATURES

- Available in white (2600 K to 8300 K CCT), 80-, 85- and 90-CRI minimum and royal blue
- White LEDs available in both parallel and series
- ANSI-compatible sub-bins
- Maximum drive current: 350 mA for parallel, 175 mA for series, 250 mA for royal blue
- 120° viewing angle, uniform chromaticity profile
- Electrically neutral thermal path

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CHARACTERISTICS (T_J = 25 °C)

Characteristics	Unit	Minimum	Typical	Maximum
Thermal resistance, junction to solder point	°C/W		13	
Viewing angle (FWHM) - white	degrees		120	
Viewing angle (FWHM) - royal blue	degrees		125	
Temperature coefficient of voltage - parallel	mV/°C		-3.4	
Temperature coefficient of voltage - series	mV/°C		-6.8	
Temperature coefficient of voltage - royal blue	mV/°C		-3.4	
ESD classification (HBM per Mil-Std-883D)			Class 2	
DC forward current - parallel	mA			350
DC forward current - series	mA			175
DC forward current - royal blue	mA			250
Reverse voltage	V			-5
Forward voltage (@ 100 mA) - parallel	V		3.2	3.4
Forward voltage (@ 50 mA) - series	V		6.4	7.0
Forward voltage (@ 100 mA) - royal blue	V		3.2	3.4
LED junction temperature	°C			150

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

The following table provides several base order codes for XLamp ML-C 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-C LED Binning and Labeling document.

Color	CCT Range		Base Order Codes Min. Luminous Flux (lm) @ 100 mA		Calculated Min. Luminous Flux (lm) @ 300 mA *	Order Code
	Min.	Max.	Group	Flux (lm)		
Cool White	5000 K	8300 K	K2	30.6	63.1	MLCAWT-A1-0000-000051
			J3	26.8	55.2	MLCAWT-A1-0000-000X51
80-CRI Cool White	6000 K	7000 K	K2	30.6	63.1	MLCAWT-H1-0000-0000E1
			J3	26.8	55.2	MLCAWT-H1-0000-000XE1
	4750 K	5250 K	K2	30.6	63.1	MLCAWT-H1-0000-0000E3
			J3	26.8	55.2	MLCAWT-H1-0000-000XE3
Warm White	3700 K	4300 K	K2	30.6	63.1	MLCAWT-A1-0000-0000E5
			J3	26.8	55.2	MLCAWT-A1-0000-000XE5
	2800 K	3200 K	K2	30.6	63.1	MLCAWT-A1-0000-0000E7
			J3	26.8	55.2	MLCAWT-A1-0000-000XE7
80-CRI Warm White	3700 K	4300 K	J3	26.8	55.2	MLCAWT-H1-0000-000XE5
	2800 K	3200 K	J2	23.5	48.4	MLCAWT-H1-0000-000WE7
85-CRI Warm White	3700 K	4300 K	J3	26.8	55.2	MLCAWT-P1-0000-000XE5
	2800 K	3200 K	J2	23.5	48.4	MLCAWT-P1-0000-000WE7
90-CRI Warm White	3700 K	4300 K	H0	18.1	37.3	MLCAWT-U1-0000-000VE5
	2800 K	3200 K	J2	23.5	48.4	MLCAWT-U1-0000-000WE7

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 (4300 K – 8300 K CCT) is 75.
- Typical CRI for Warm White (2600 K – 4300 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-C SERIES WHITE (T_J = 25 °C)

The following table provides several base order codes for XLamp ML-C 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-C LED Binning and Labeling document.

Color	CCT Range		Base Order Codes Min. Luminous Flux (lm) @ 50 mA		Calculated Min. Luminous Flux (lm) @ 150 mA *	Order Code
	Min.	Max.	Group	Flux (lm)		
Cool White	5000 K	8300 K	K2	30.6	63.1	MLCSWT-A1-0000-000051
			J3	26.8	55.2	MLCSWT-A1-0000-000X51
80-CRI Cool White	6000 K	7000 K	K2	30.6	63.1	MLCSWT-H1-0000-0000E1
			J3	26.8	55.2	MLCSWT-H1-0000-000XE1
	4750 K	5250 K	K2	30.6	63.1	MLCSWT-H1-0000-0000E3
			J3	26.8	55.2	MLCSWT-H1-0000-000XE3
Warm White	3700 K	4300 K	K2	30.6	63.1	MLCSWT-A1-0000-0000E5
			J3	26.8	55.2	MLCSWT-A1-0000-000XE5
	2800 K	3200 K	K2	30.6	63.1	MLCSWT-A1-0000-0000E7
			J3	26.8	55.2	MLCSWT-A1-0000-000XE7
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85-CRI Warm White	3700 K	4300 K	J3	26.8	55.2	MLCSWT-P1-0000-000XE5
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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 (4300 K – 8300 K CCT) is 75.
- Typical CRI for Warm White (2600 K – 4300 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.

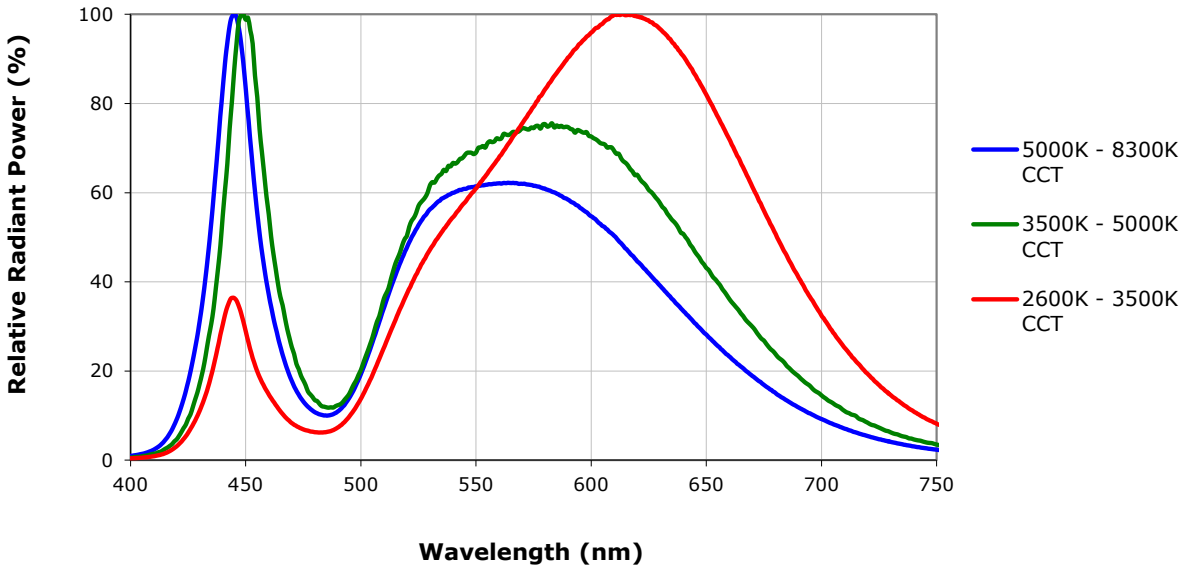
FLUX CHARACTERISTICS - ML-C ROYAL BLUE (T_J = 25 °C)

The following table provides a base order code for XLamp ML-C Royal Blue 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.

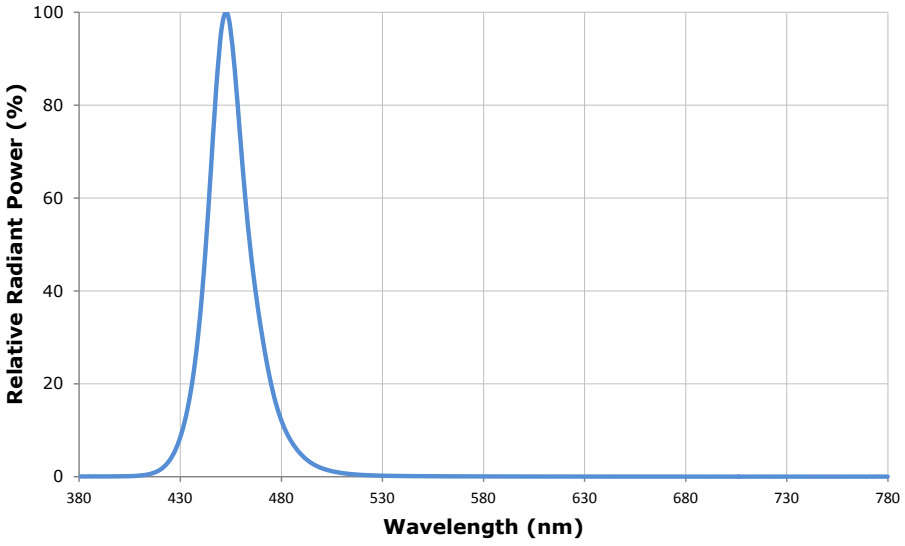
Color	Dominant Wavelength Range				Base Order Codes Minimum Radiant Flux (mW) @ 100 mA		Order Code
	Min.		Max.				
	Group	DWL (nm)	Group	DWL (nm)	Group	Flux (mW)	
Royal Blue	D3	450	D5	465	07	100	MLCROY-A1-0000-000201

Note: Cree maintains a tolerance of ± 7% on flux and power measurements and ± 1 nm on dominant wavelength measurements.

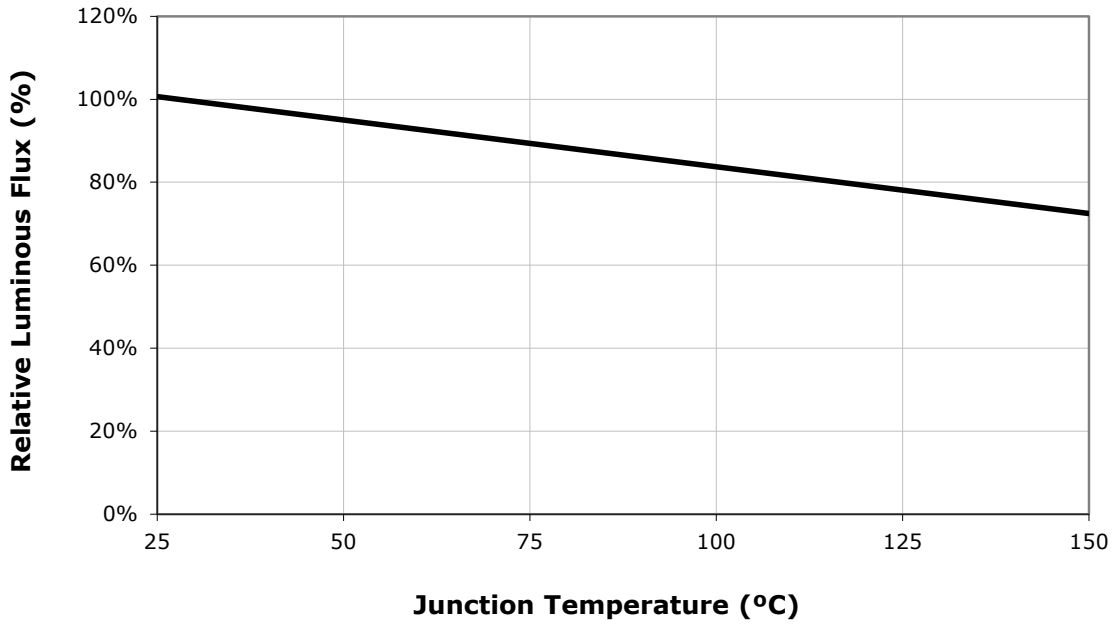
RELATIVE SPECTRAL POWER DISTRIBUTION - WHITE



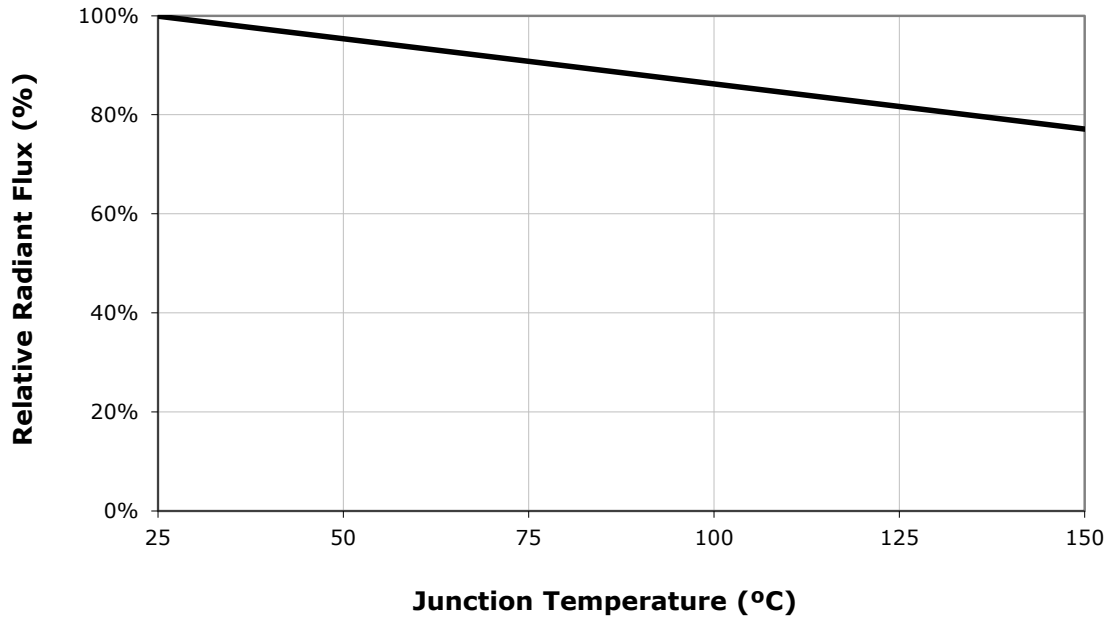
RELATIVE SPECTRAL POWER DISTRIBUTION - ROYAL BLUE



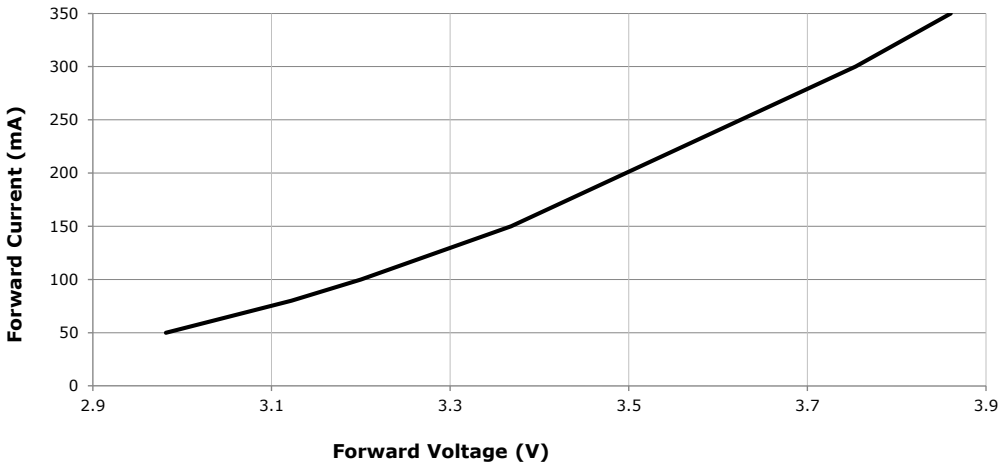
RELATIVE LUMINOUS FLUX VS. JUNCTION TEMPERATURE - WHITE (ML-C PARALLEL: I_F = 100 mA, ML-C SERIES: I_F = 50 mA)



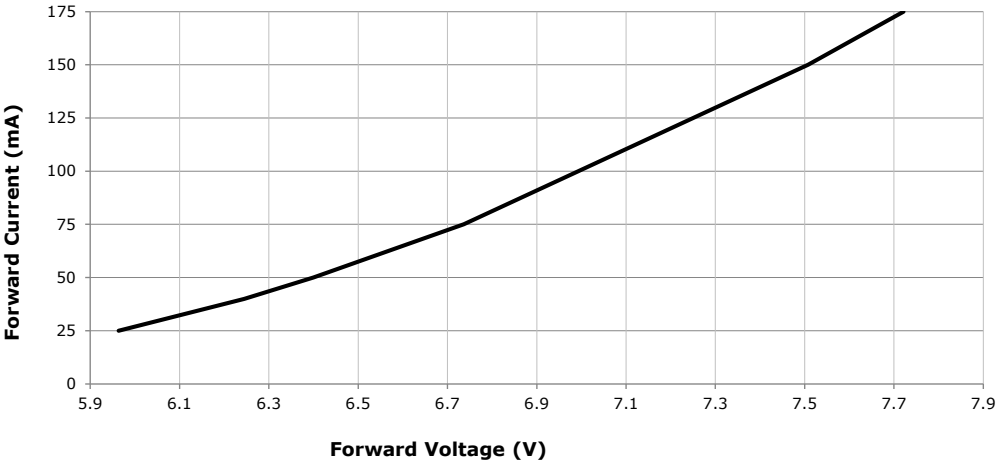
RELATIVE RADIANT FLUX VS. JUNCTION TEMPERATURE - ROYAL BLUE (I_F = 100 mA)



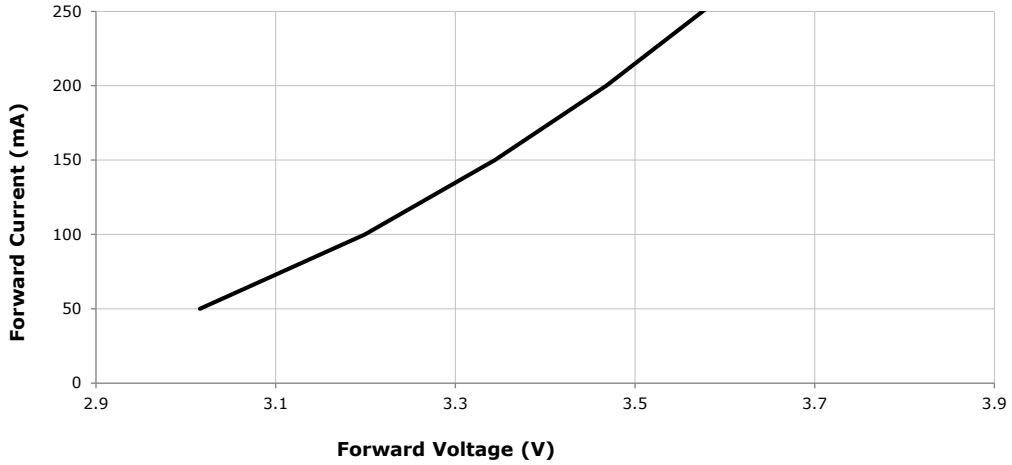
ELECTRICAL CHARACTERISTICS - ML-C PARALLEL WHITE (T_J = 25 °C)



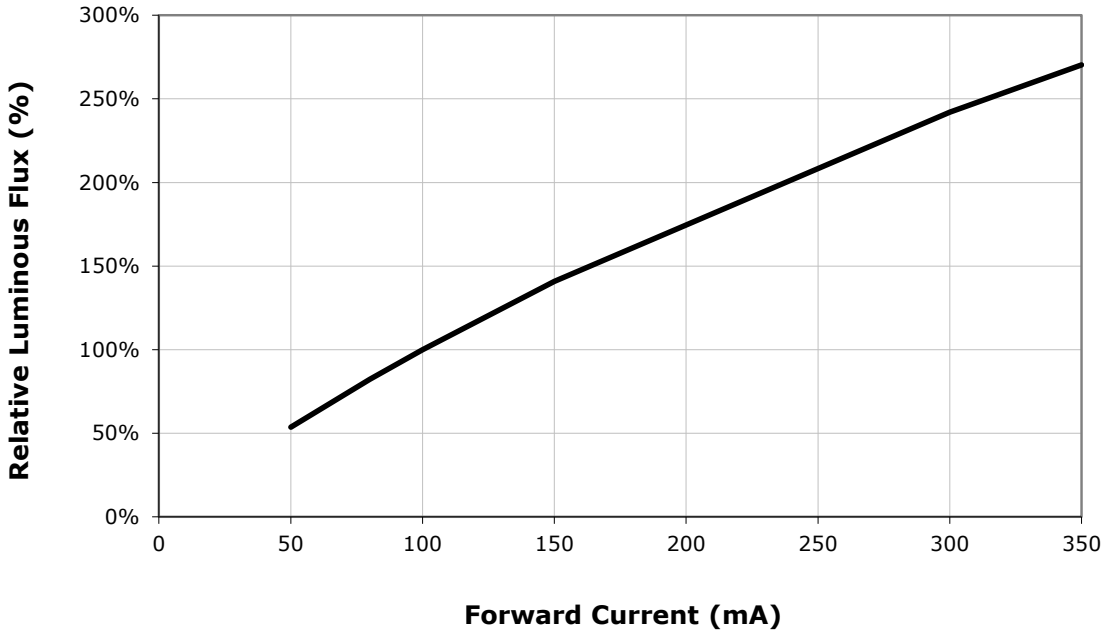
ELECTRICAL CHARACTERISTICS - ML-C SERIES WHITE (T_J = 25 °C)



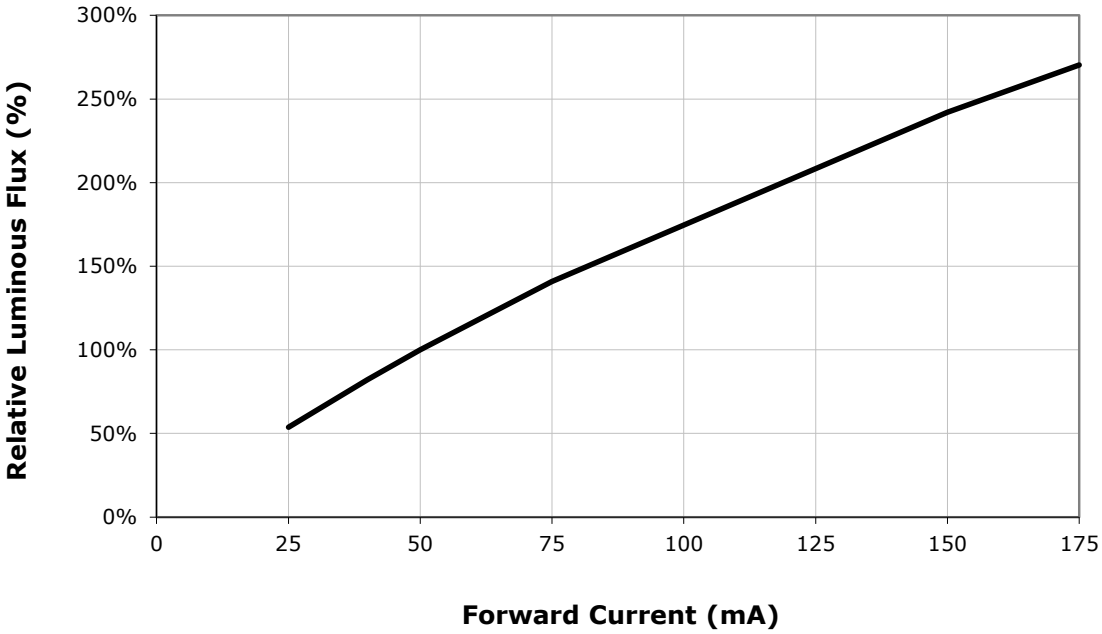
ELECTRICAL CHARACTERISTICS - ROYAL BLUE (T_J = 25 °C)



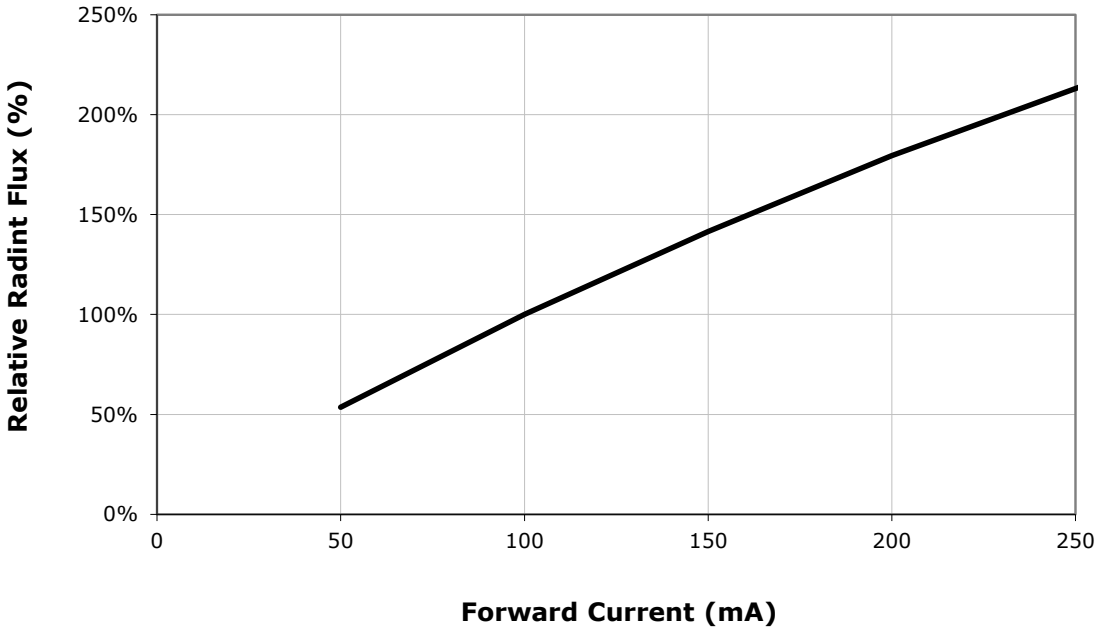
RELATIVE LUMINOUS FLUX VS. CURRENT - ML-C PARALLEL WHITE (T_J = 25 °C)



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

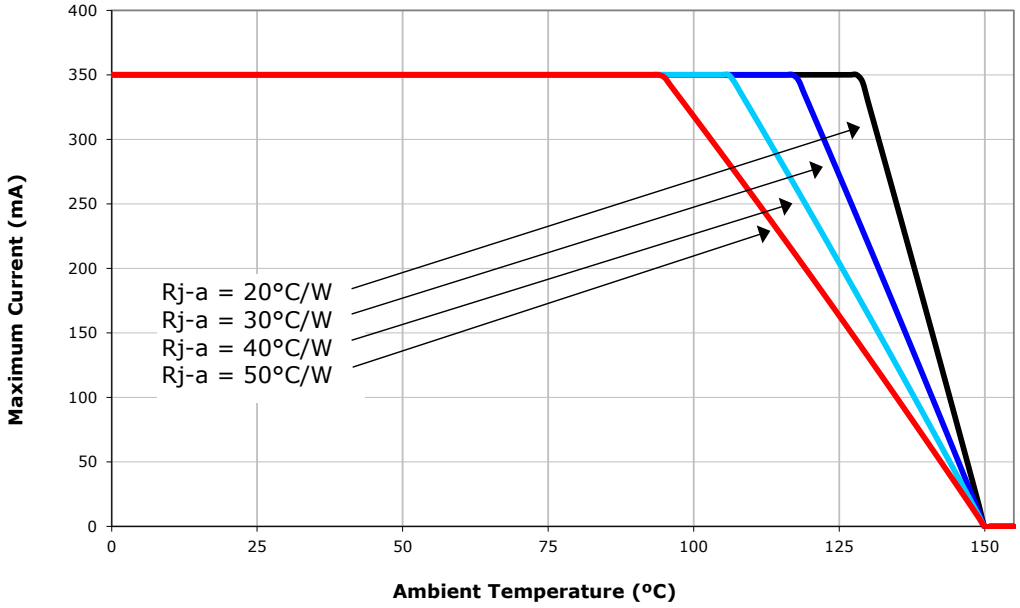


RELATIVE RADIANT FLUX VS. CURRENT - ROYAL BLUE (T_J = 25 °C)

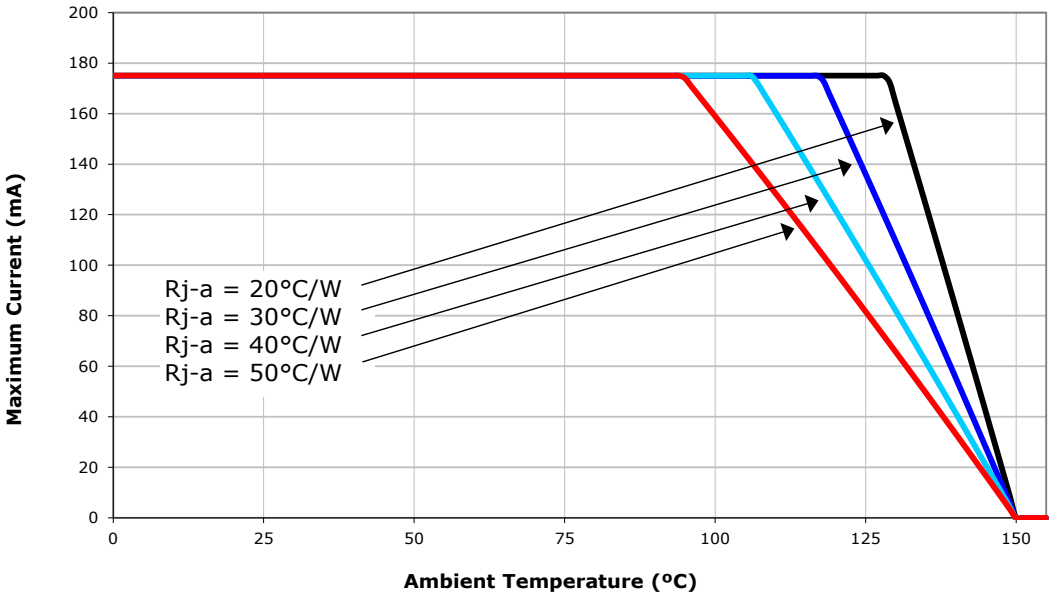


THERMAL DESIGN - ML-C PARALLEL WHITE

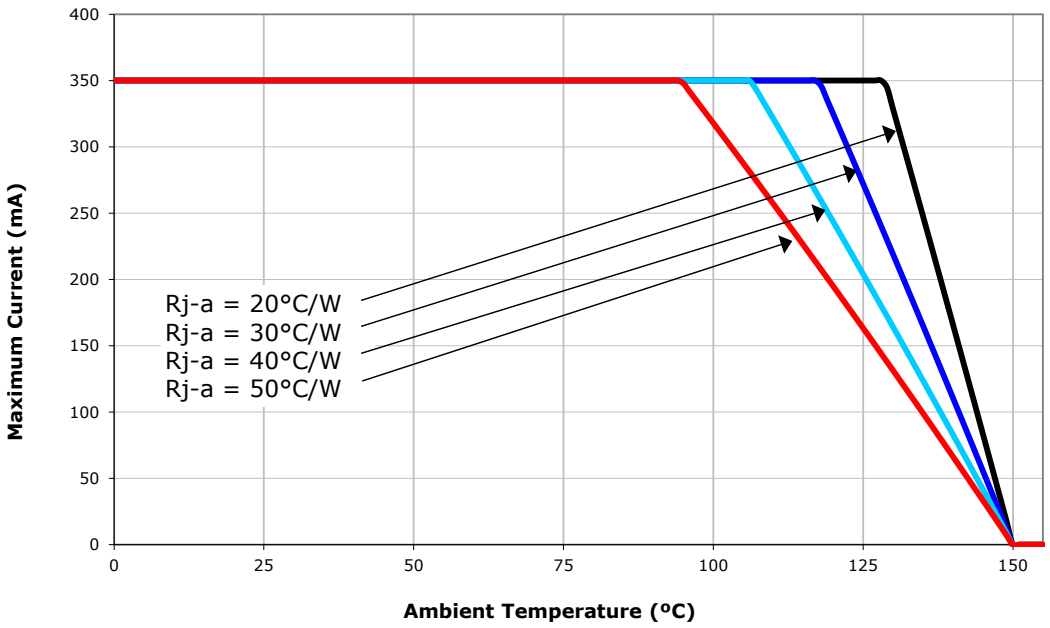
The maximum forward current is determined by the thermal resistance between the LED junction and ambient. It is crucial for the end product to be designed in a manner that minimizes the thermal resistance from the solder point to ambient in order to optimize lamp life and optical characteristics.



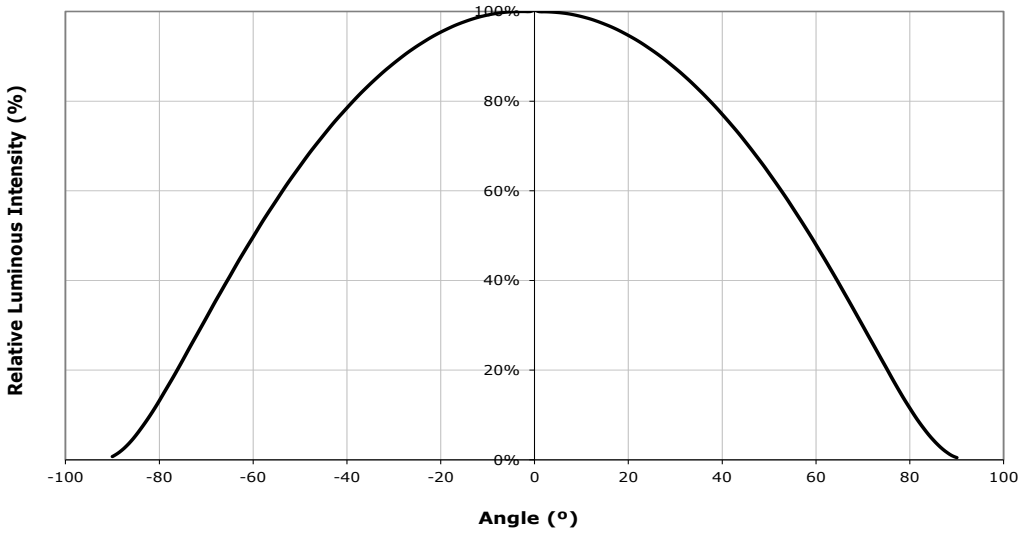
THERMAL DESIGN - ML-C SERIES WHITE



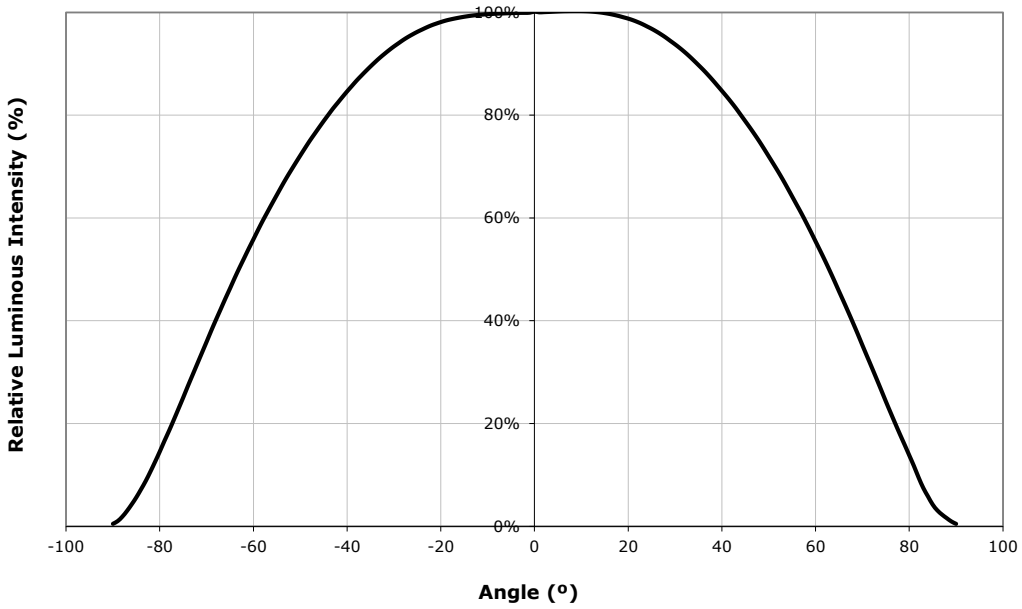
THERMAL DESIGN - ROYAL BLUE



TYPICAL SPATIAL DISTRIBUTION - WHITE



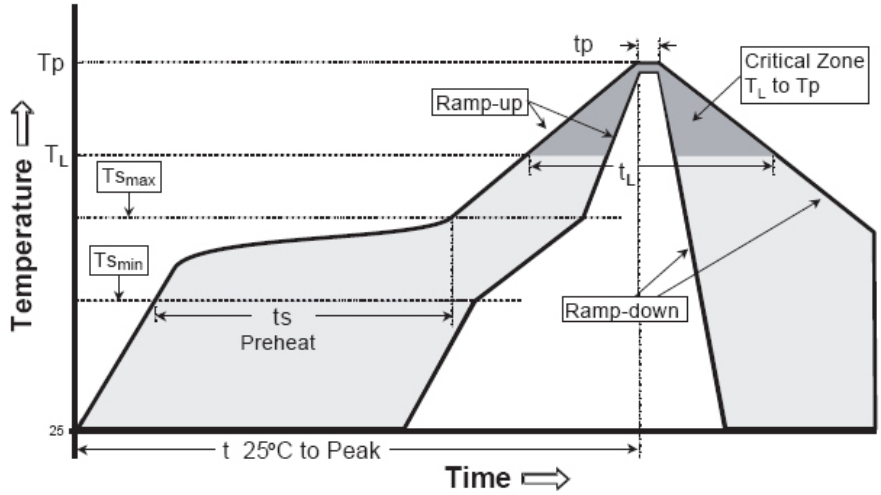
TYPICAL SPATIAL DISTRIBUTION - ROYAL BLUE



REFLOW SOLDERING CHARACTERISTICS

In testing, Cree has found XLamp ML-C 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.



IPC/JEDEC J-STD-020C

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.

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.

Moisture Sensitivity

XLamp ML-C LEDs are shipped in sealed, moisture-barrier bags (MBB) designed for long shelf life. If XLamp ML-C LEDs are exposed to moist environments after opening the MBB packaging but before soldering, damage to the LED may occur during the soldering operation. The derating table at right defines the maximum exposure time (in days) for an XLamp ML-C LED in the listed humidity and temperature conditions. LEDs with exposure time longer than the time specified below must be baked according to the baking conditions listed below.

Temp.	Maximum Percent Relative Humidity						
	30%	40%	50%	60%	70%	80%	90%
35 ºC	-	-	-	17	1	.5	.5
30 ºC	-	-	-	28	1	1	1
25 ºC	-	-	-	-	2	1	1
20 ºC	-	-	-	-	2	1	1

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.

Baking Conditions

It is not necessary to bake all XLamp ML-C LEDs. Only the LEDs that meet all of the following criteria must be baked:

1. LEDs that have been removed from the original MBB packaging.
2. LEDs that have been exposed to a humid environment longer than listed in the Moisture Sensitivity section above.
3. LEDs that have not been soldered.

LEDs should be baked at 70 ºC for 24 hours. LEDs may be baked on the original reels. Remove LEDs from MBB packaging before baking. Do not bake parts at temperatures higher than 70 ºC. This baking operation resets the exposure time as defined in the Moisture Sensitivity section above.

Storage Conditions

XLamp ML-C LEDs that have been removed from the original MBB packaging but not soldered should be stored in one of the following ways:

- Store the parts in a rigid metal container with a tight-fitting lid. Verify that the storage temperature is <30 °C, and place fresh desiccant and an RH indicator in the container to verify that the RH is no greater than 60%.
- Store the parts in a dry, nitrogen-purged cabinet or container that actively maintains the temperature at <30° and the RH at no greater than 60%.
- For short-term store only: LEDs can be resealed in the original MBB bag soon after opening. Fresh desiccant may be needed. Use the included humidity indicator card to verify <60% RH.

If an environment of <60% RH is not available for storage, XLamp ML-C LEDs should be baked (described above) before reflow soldering.

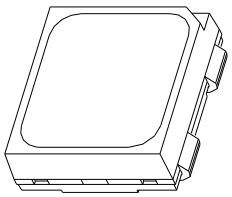
Vision Advisory Claim

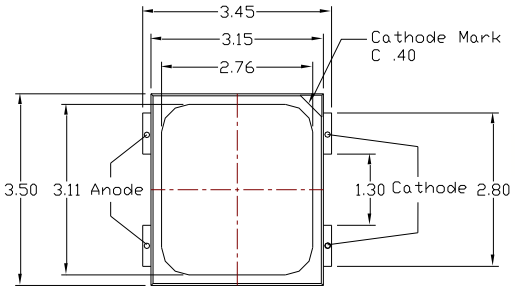
WARNING. Do not look at exposed LED lamps in operation. Eye injury can result. For more information about LEDs and eye safety, please refer to the Cree LED Eye Safety Application Note (www.cree.com/xlamp_app_notes/led_eye_safety).

MECHANICAL DIMENSIONS (T_A = 25 °C)

All measurements are ±.13 mm unless otherwise indicated.

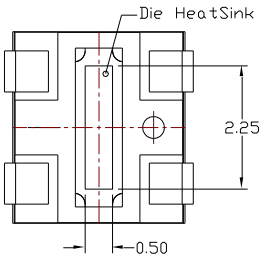
Top View

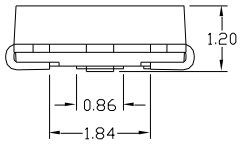




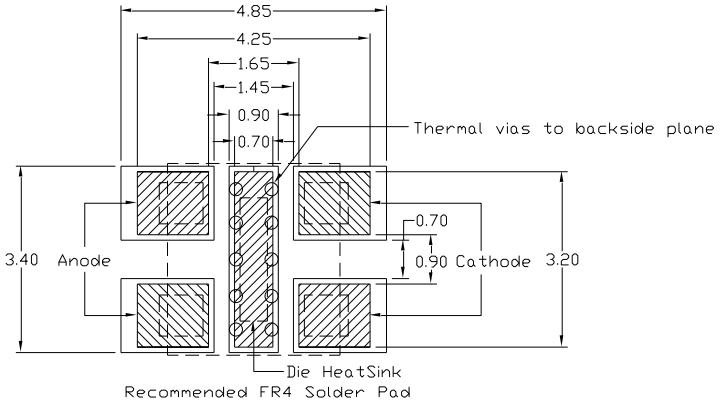
Top View

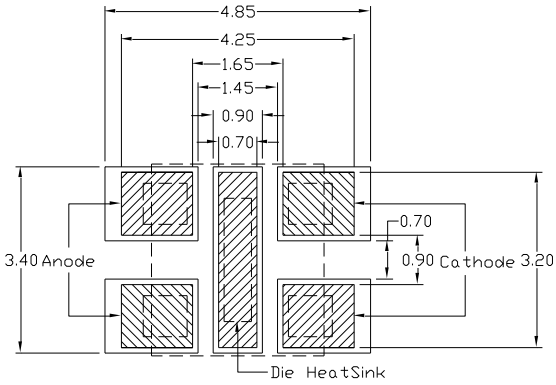
Bottom View



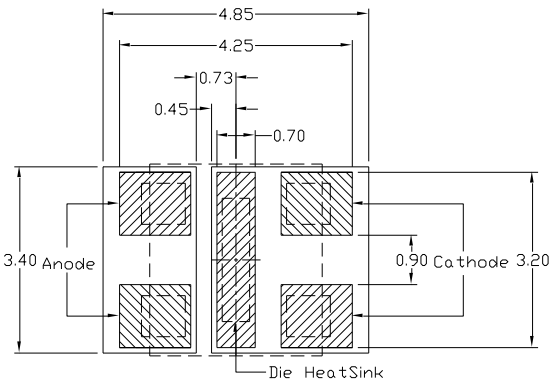


Side View





Recommended MCPCB Solder Pad

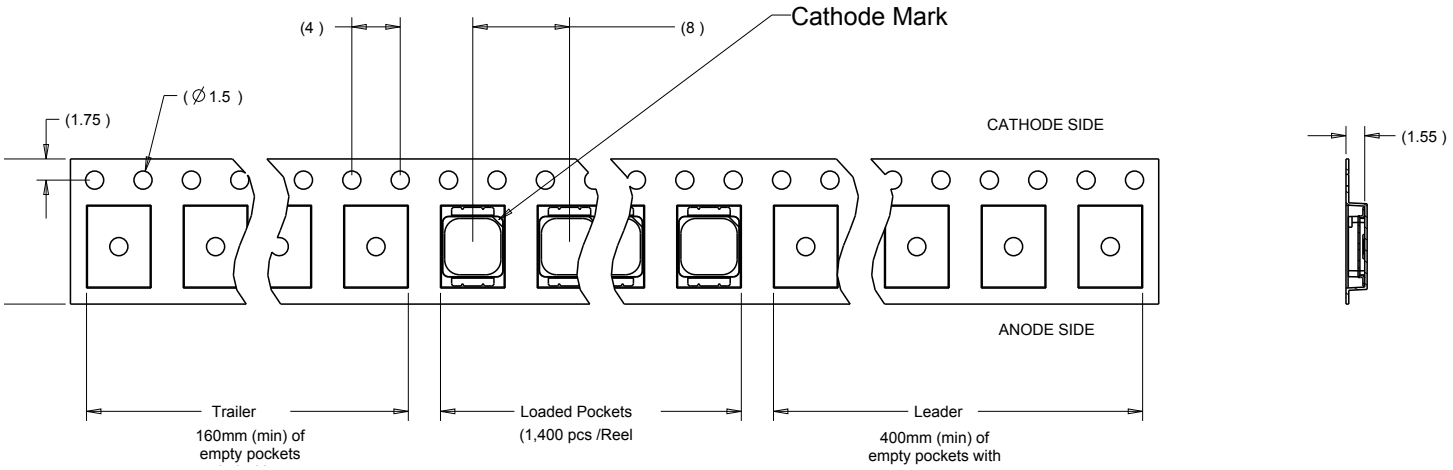


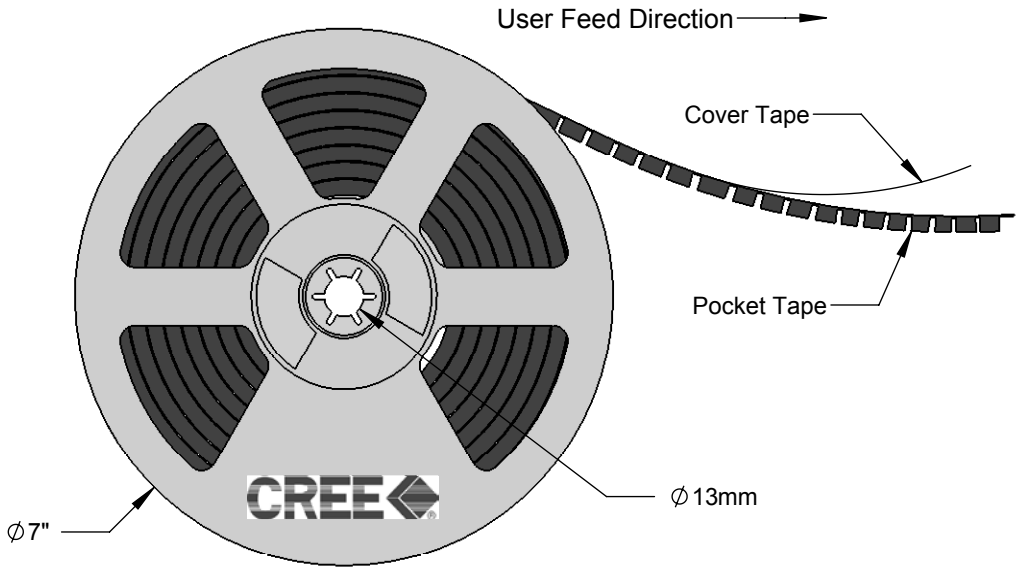
Alternative Solder Pad

TAPE AND REEL

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

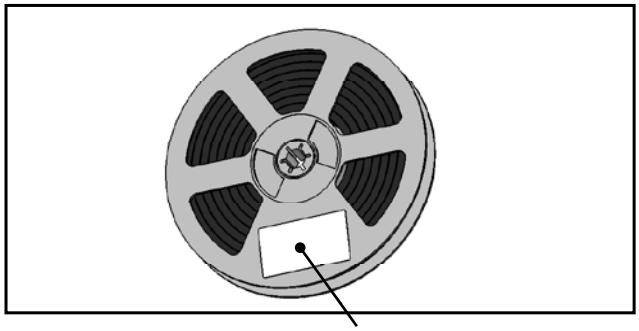
All dimensions in mm.



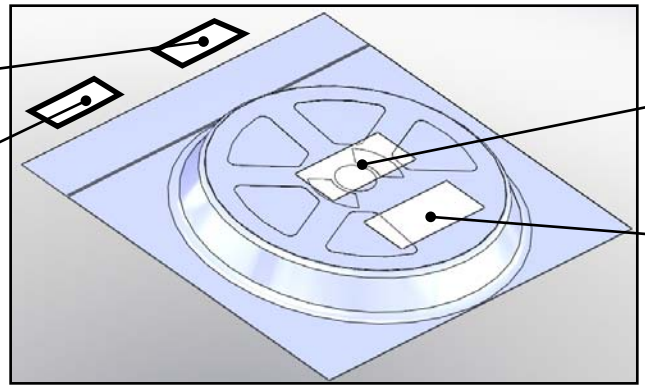


PACKAGING

Unpackaged Reel



Packaged Reel



Boxed Reel