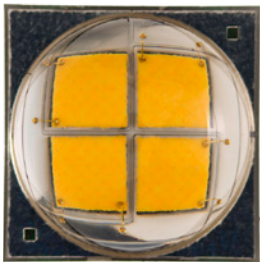
Cree® XLamp® MK-R LEDs



PRODUCT DESCRIPTION

Built on Cree's revolutionary SC³ Technology™ platform, the XLamp MK-R LED brings new levels of price and performance to directional LED arrays, enabling lighting manufacturers to create the next generation of high-lumen indoor and outdoor LED lighting systems. In single-LED systems, the XLamp MK-R, with EasyWhite™ color binning, provides the LED industry's tightest unit-to-unit color consistency. For systems using multiple LEDs, the MK-R enables manufacturers to use fewer LEDs while maintaining light output and color consistency, which translates to lower system cost.

The XLamp MK-R is optimized for directional lighting applications and is a welcome addition to applications requiring high lumen output, a compact optical source and a broad palette of color temperature and CRI values.

FEATURES

- Available in ANSI white bins as well as 4-step and 2-step EasyWhite bins at 2700 K, 3000 K, 3500 K, 4000 K, 4500 K and 5000 K CCT
- Maximum drive current: 1250 mA
- Low thermal resistance: 1.7 °C/W
- Maximum junction temperature: 150 °C
- Binned at 85 °C
- Viewing angle: 120°
- Available in cool white, 70-, 80- and 90-CRI minimums
- Unlimited floor life at ≤ 30 ºC/85% RH
- Reflow solderable - JEDEC J-STD-020C
- Electrically neutral thermal path
- UL-recognized component (E349212)

TABLE OF CONTENTS

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CHARACTERISTICS

Characteristics	Unit	Minimum	Typical	Maximum
Thermal resistance, junction to solder point	°C/W		1.7	
Viewing angle - full width half maximum (FWHM)	degrees		120	
Temperature coefficient of voltage	mV/°C		-7	
ESD classification (HBM per Mil-Std-883D)			Class 2	
DC forward current	mA			1250
Reverse voltage	V			-5
Forward voltage (@ 700 mA, 85 °C)	V		11.7	14
LED junction temperature	°C			150

FLUX CHARACTERISTICS, STANDARD ORDER CODES AND BINS (I_F = 700 mA, T_J = 85 °C)

The following tables provide order codes for XLamp MK-R EasyWhite LEDs. For a complete description of the order code nomenclature, please reference Bin and Order Code Formats (page 14).

Color	CCT Range	Base Order Codes Min. Luminous Flux @ 700 mA			2-Step Order Code		4-Step Order Code	
		Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C*	Chromaticity Region		Chromaticity Region	
80-CRI EasyWhite	5000 K	H2	900	1044	50H	MKRAWT-00-0000-0D0HH250H	50F	MKRAWT-00-0000-0D0HH250F
		G4	840	974		MKRAWT-00-0000-0D0HG450H		MKRAWT-00-0000-0D0HG450F
	4500 K	H2	900	1044	45H	MKRAWT-00-0000-0D0HH245H	45F	MKRAWT-00-0000-0D0HH245F
		G4	840	974		MKRAWT-00-0000-0D0HG445H		MKRAWT-00-0000-0D0HG445F
	4000 K	H2	900	1044	40H	MKRAWT-00-0000-0D0HH240H	40F	MKRAWT-00-0000-0D0HH240F
		G4	840	974		MKRAWT-00-0000-0D0HG440H		MKRAWT-00-0000-0D0HG440F
	3500 K	H2	900	1044	35H	MKRAWT-00-0000-0D0HH235H	35F	MKRAWT-00-0000-0D0HH235F
		G4	840	974		MKRAWT-00-0000-0D0HG435H		MKRAWT-00-0000-0D0HG435F
	3000 K	G4	840	974	30H	MKRAWT-00-0000-0D0HG430H	30F	MKRAWT-00-0000-0D0HG430F
		G2	780	905		MKRAWT-00-0000-0D0HG230H		MKRAWT-00-0000-0D0HG230F
	2700 K	G2	780	905	27H	MKRAWT-00-0000-0D0HG227H	27F	MKRAWT-00-0000-0D0HG227F
		F4	730	847		MKRAWT-00-0000-0D0HF427H		MKRAWT-00-0000-0D0HF427F
90-CRI EasyWhite	3000 K	E4	635	737	30H	MKRAWT-00-0000-0D0UE430H	30F	MKRAWT-00-0000-0D0UE430F
		E2	590	684		MKRAWT-00-0000-0D0UE230H		MKRAWT-00-0000-0D0UE230F
	2700 K	E2	590	684	27H	MKRAWT-00-0000-0D0UE227H	27F	MKRAWT-00-0000-0D0UE227F
		D4	550	638		MKRAWT-00-0000-0D0UD427H		MKRAWT-00-0000-0D0UD427F

Notes:

- Cree maintains a tolerance of ± 7% on flux and power measurements, ± 0.005 on chromaticity (CCx, CCy) measurements and ± 2 on CRI measurements.
- Minimum CRI for 80-CRI White is 80.
- Minimum CRI for 90-CRI White is 90.

* Flux values @ 25 °C are calculated and for reference only.

STANDARD ORDER CODES AND BINS, ANSI WHITE (I_F = 700 mA, T_J = 85 °C)

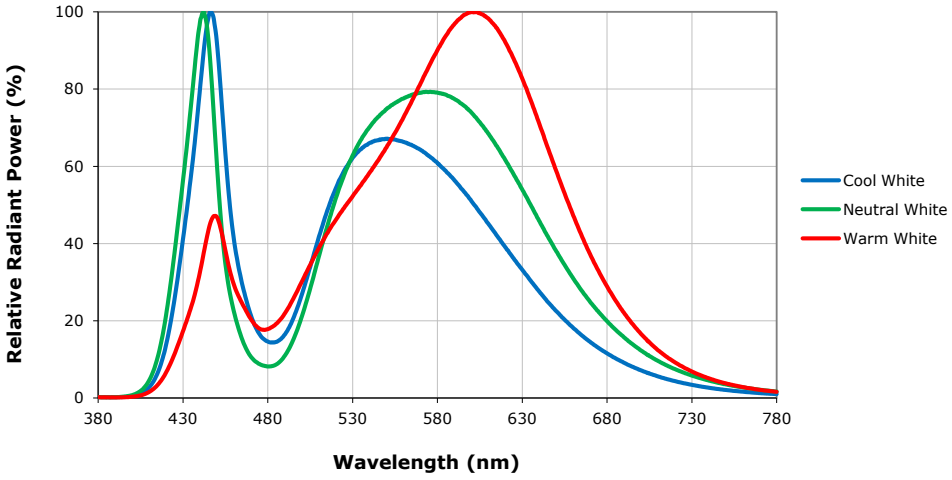
XLamp MK-R Standard ANSI Kit Codes								
Chromaticity		Minimum Luminous Flux (lm) @ 700 mA**			Order Codes			
Kit	CCT	Code	Flux (lm)@ 85 °C	Flux (lm) @ 25 °C*	65 CRI Typical	70 CRI Minimum	80 CRI Minimum	90 CRI Minimum
ANSI White (2700 K - 8300 K)								
51	6200 K	J2	1040	1206	MKRAWT-00-0000-0D00J2051			
		H4	970	1125	MKRAWT-00-0000-0D00H4051	MKRAWT-00-0000-0D0BH4051		
		H2	900	1044		MKRAWT-00-0000-0D0BH2051		
E1	6500 K	J2	1040	1206	MKRAWT-00-0000-0D00J20E1			
		H4	970	1125	MKRAWT-00-0000-0D00H40E1	MKRAWT-00-0000-0D0BH40E1		
		H2	900	1044		MKRAWT-00-0000-0D0BH20E1		
E2	5700 K	J2	1040	1206	MKRAWT-00-0000-0D00J20E2			
		H4	970	1125	MKRAWT-00-0000-0D00H40E2	MKRAWT-00-0000-0D0BH40E2		
		H2	900	1044		MKRAWT-00-0000-0D0BH20E2		
E3	5000 K	H4	970	1125	MKRAWT-00-0000-0D00H40E3	MKRAWT-00-0000-0D0BH40E3		
		H2	900	1044	MKRAWT-00-0000-0D00H20E3	MKRAWT-00-0000-0D0BH20E3	MKRAWT-00-0000-0D0HH20E3	
		G4	840	974			MKRAWT-00-0000-0D0HG40E3	
E4	4500 K	H4	970	1125	MKRAWT-00-0000-0D00H40E4	MKRAWT-00-0000-0D0BH40E4		
		H2	900	1044	MKRAWT-00-0000-0D00H20E4	MKRAWT-00-0000-0D0BH20E4	MKRAWT-00-0000-0D0HH20E4	
		G4	840	974			MKRAWT-00-0000-0D0HG40E4	
E5	4000 K	H2	900	1044	MKRAWT-00-0000-0D00H20E5	MKRAWT-00-0000-0D0BH20E5	MKRAWT-00-0000-0D0HH20E5	
		G4	840	974	MKRAWT-00-0000-0D00G40E5	MKRAWT-00-0000-0D0BG40E5	MKRAWT-00-0000-0D0HG40E5	
E6	3500 K	H2	900	1044		MKRAWT-00-0000-0D0BH20E6	MKRAWT-00-0000-0D0HH20E6	
		G4	840	974		MKRAWT-00-0000-0D0BG40E6	MKRAWT-00-0000-0D0HG40E6	
E7	3000 K	G4	840	974			MKRAWT-00-0000-0D0HG40E7	
		G2	780	905			MKRAWT-00-0000-0D0HG20E7	
		F4	730	847				
		F2	680	789				
		E4	635	737				MKRAWT-00-0000-0D0UE40E7
		E2	590	684				MKRAWT-00-0000-0D0UE20E7
E8	2700 K	G2	780	905			MKRAWT-00-0000-0D0HG20E8	
		F4	730	847			MKRAWT-00-0000-0D0HF40E8	
		F2	680	789				
		E4	635	737				
		E2	590	684				MKRAWT-00-0000-0D0UE20E8
		D4	550	638				MKRAWT-00-0000-0D0UD40E8

** Cree XLamp MK-R 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 restrictions specified by the order code.

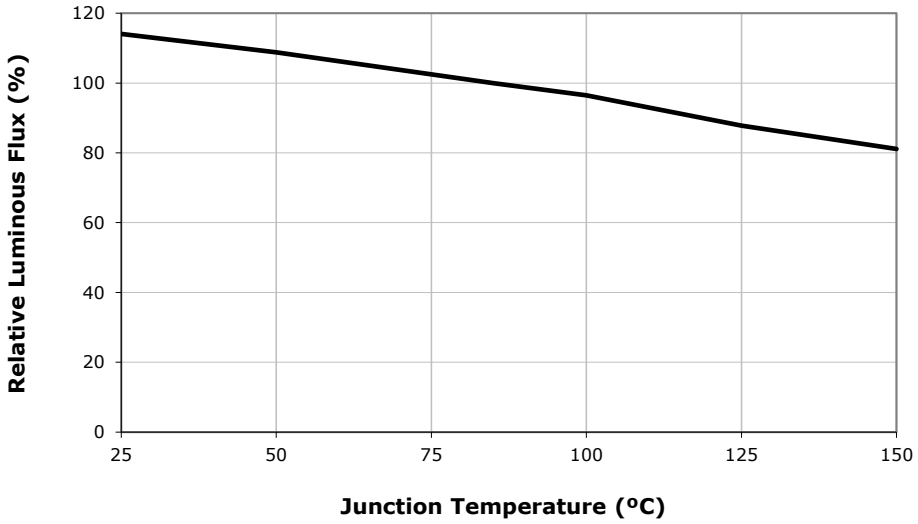
* Flux values @ 25 °C are calculated and for reference only.

- For information on chromaticity bins contained in the kits listed above, please reference the Performance Groups - Chromaticity section starting on page 8.
- Minimum CRI for 70-CRI White is 70.

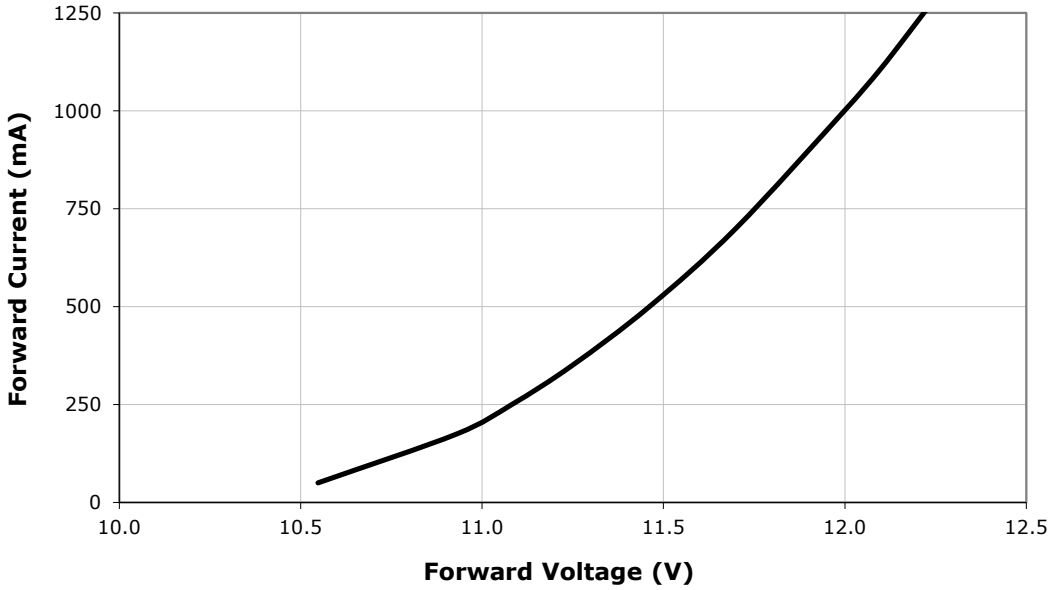
RELATIVE SPECTRAL POWER DISTRIBUTION



RELATIVE FLUX VS. JUNCTION TEMPERATURE (I_F = 700 mA)

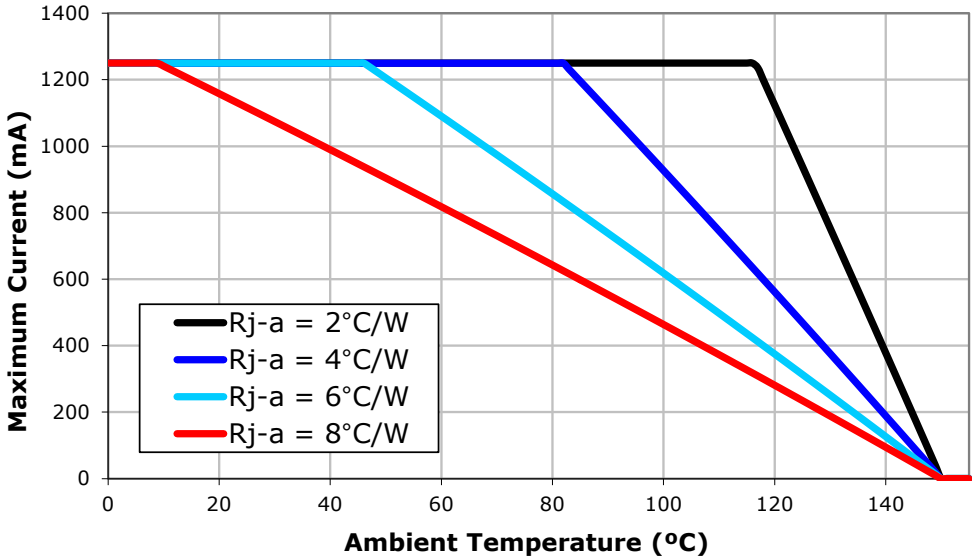


ELECTRICAL CHARACTERISTICS (T_J = 85 °C)

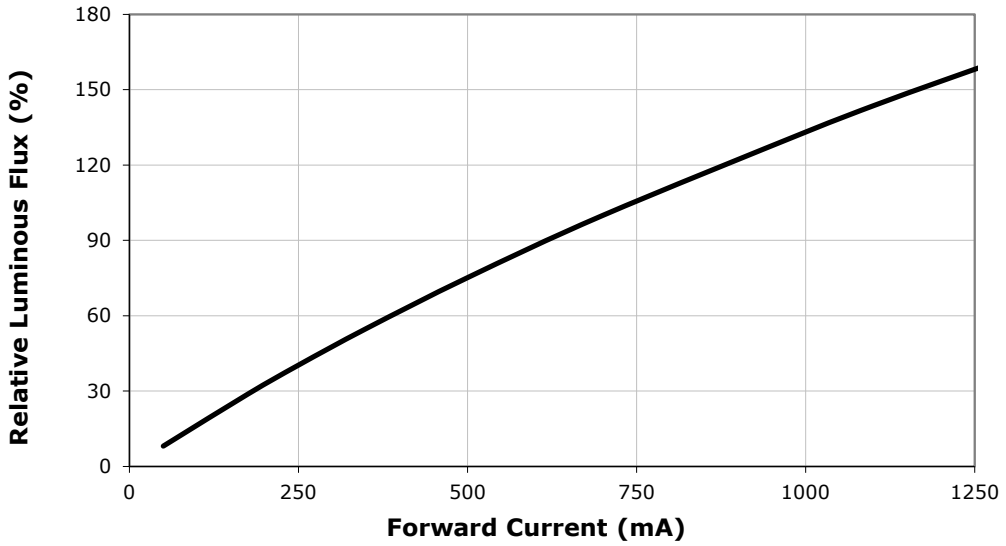


THERMAL DESIGN

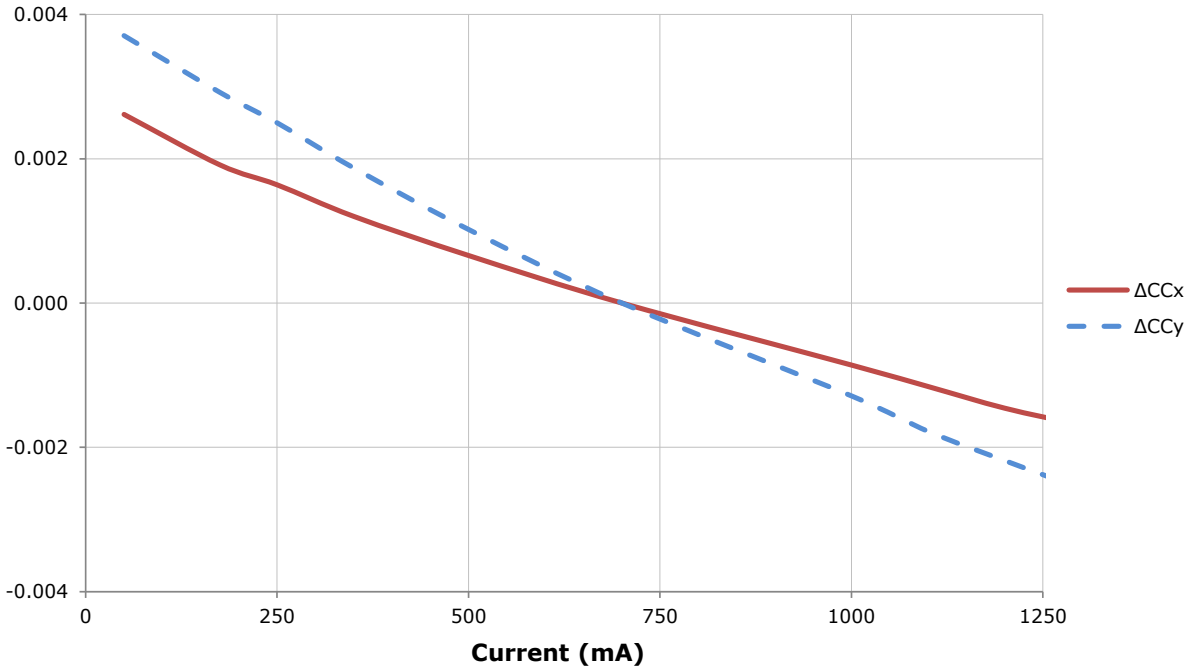
The maximum forward current is determined by the thermal resistance between the LED junction and ambient. It is crucial for the end product to be designed in a manner that minimizes the thermal resistance from the solder point to ambient in order to optimize lamp life and optical characteristics.



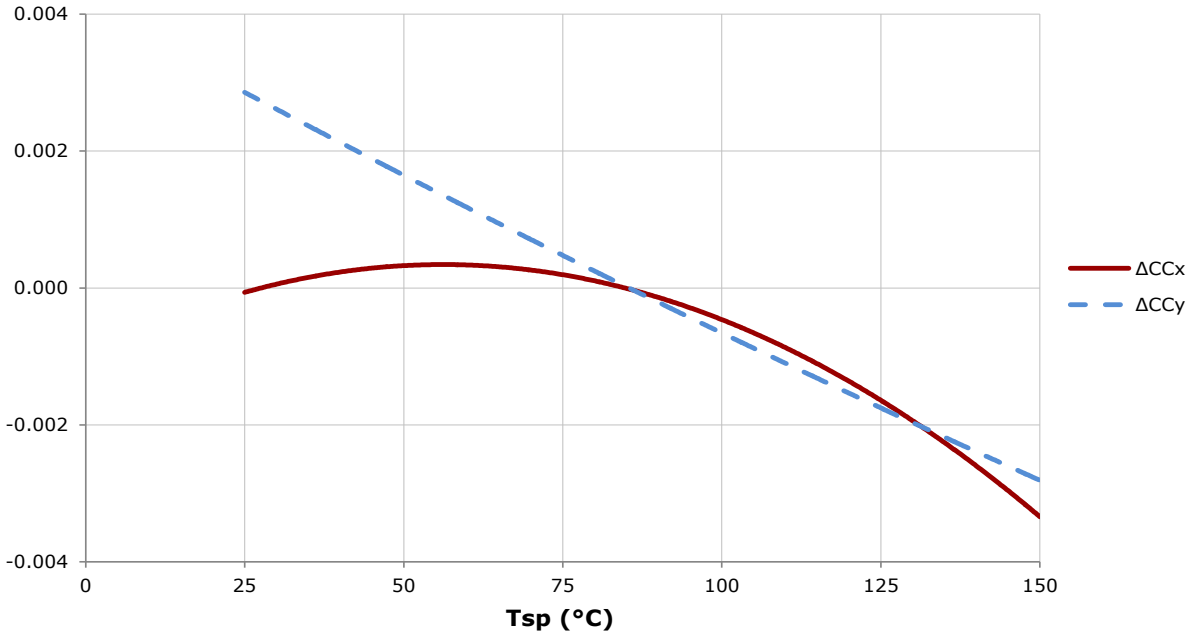
RELATIVE FLUX VS. CURRENT (T_J = 85 °C)



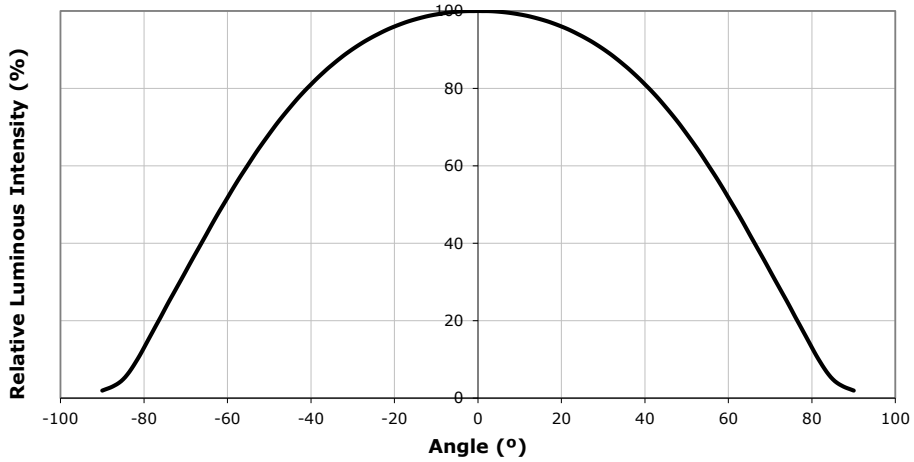
RELATIVE CHROMATICITY VS. CURRENT - WARM WHITE (T_J = 85 °C)



RELATIVE CHROMATICITY VS. TEMPERATURE - WARM WHITE (I_F = 700 mA)



TYPICAL SPATIAL DISTRIBUTION



PERFORMANCE GROUPS - BRIGHTNESS (I_F = 700 mA, T_J = 85 °C)

XLamp MK-R LEDs are tested for luminous flux and placed into one of the following bins.

Group Code	Min. Luminous Flux @ 700 mA	Max. Luminous Flux @ 700 mA
D2	510	550
D4	550	590
E2	590	635
E4	635	680
F2	680	730
F4	730	780
G2	780	840
G4	840	900
H2	900	970
H4	970	1040
J2	1040	1120
J4	1120	1200
K2	1200	1290

PERFORMANCE GROUPS - CHROMATICITY (T_J = 85 °C)

XLamp MK-R LEDs are tested for chromaticity and placed into one of the regions defined by the following bounding coordinates.

EasyWhite Color Temperatures – 4-Step			
Code	**CCT**	**x**	**y**
50F	5000 K	0.3407	0.3459
		0.3415	0.3586
		0.3499	0.3654
		0.3484	0.3521
45F	4500 K	0.3674	0.3772
		0.3582	0.3710
		0.3562	0.3573
		0.3642	0.3625
40F	4000 K	0.3744	0.3685
		0.3782	0.3837
		0.3912	0.3917
		0.3863	0.3758
35F	3500 K	0.3981	0.3800
		0.4040	0.3966
		0.4186	0.4037
		0.4116	0.3865
30F	3000 K	0.4242	0.3919
		0.4322	0.4096
		0.4449	0.4141
		0.4359	0.3960
27F	2700 K	0.4475	0.3994
		0.4573	0.4178
		0.4695	0.4207
		0.4589	0.4021

EasyWhite Color Temperatures – 2-Step			
Code	**CCT**	**x**	**y**
50H	5000 K	0.3429	0.3507
		0.3434	0.3571
		0.3475	0.3604
		0.3469	0.3539
45H	4500 K	0.3643	0.3720
		0.3597	0.3689
		0.3587	0.3620
		0.3628	0.3647
40H	4000 K	0.3784	0.3741
		0.3804	0.3818
		0.3867	0.3857
		0.3844	0.3778
35H	3500 K	0.4030	0.3857
		0.4061	0.3941
		0.4132	0.3976
		0.4099	0.3890
30H	3000 K	0.4291	0.3973
		0.4333	0.4062
		0.4395	0.4084
		0.4351	0.3994
27H	2700 K	0.4528	0.4046
		0.4578	0.4138
		0.4638	0.4152
		0.4586	0.4060

PERFORMANCE GROUPS - CHROMATICITY (T_J = 85 °C) - CONTINUED

ANSI White Bins												
Code	CCT	Bin Code	x	y	Bin Code	x	y	Bin Code	x	y	Bin Code	x	y
051	6200 K	0A0	0.2920	0.3060	0R0	0.2950	0.2970	1A0	0.3048	0.3207	1R0	0.3068	0.3113
			0.2984	0.3133		0.3009	0.3042		0.3130	0.3290		0.3144	0.3186
			0.3009	0.3042		0.3037	0.2937		0.3144	0.3186		0.3161	0.3059
			0.2950	0.2970		0.2980	0.2880		0.3068	0.3113		0.3093	0.2993
		0B0	0.2895	0.3135	0S0	0.2870	0.3210	1B0	0.3028	0.3304	1S0	0.3005	0.3415
			0.2962	0.3220		0.2937	0.3312		0.3115	0.3391		0.3099	0.3509
			0.2984	0.3133		0.2962	0.3220		0.3130	0.3290		0.3115	0.3391
			0.2920	0.3060		0.2895	0.3135		0.3048	0.3207		0.3028	0.3304
		0C0	0.2962	0.3220	0T0	0.2937	0.3312	1C0	0.3115	0.3391	1T0	0.3099	0.3509
			0.3028	0.3304		0.3005	0.3415		0.3205	0.3481		0.3196	0.3602
			0.3048	0.3207		0.3028	0.3304		0.3213	0.3373		0.3205	0.3481
			0.2984	0.3133		0.2962	0.3220		0.3130	0.3290		0.3115	0.3391
		0D0	0.2984	0.3133	0U0	0.3009	0.3042	1D0	0.3130	0.3290	1U0	0.3144	0.3186
			0.3048	0.3207		0.3068	0.3113		0.3213	0.3373		0.3221	0.3261
			0.3068	0.3113		0.3093	0.2993		0.3221	0.3261		0.3231	0.3120
			0.3009	0.3042		0.3037	0.2937		0.3144	0.3186		0.3161	0.3059

ANSI White Bins										
Code	CCT	Bin Code	x	y	Bin Code	x	y	Bin Code	x	y
051	6200 K	2A0	0.3215	0.3350	2R0	0.3222	0.3243	3A0	.3371	.3490
			0.3290	0.3417		0.3290	0.3300		.3451	.3554
			0.3290	0.3300		0.3290	0.3180		.3440	.3427
			0.3222	0.3243		0.3231	0.3120		.3366	.3369
		2B0	0.3207	0.3462	2S0	0.3196	0.3602	3B0	.3376	.3616
			0.3290	0.3538		0.3290	0.3690		.3463	.3687
			0.3290	0.3417		0.3290	0.3538		.3451	.3554
			0.3215	0.3350		0.3207	0.3462		.3371	.3490
		2C0	0.3290	0.3538	2T0	0.3290	0.3690	3C0	.3463	.3687
			0.3376	0.3616		0.3381	0.3762		.3551	.3760
			0.3371	0.3490		0.3376	0.3616		.3533	.3620
			0.3290	0.3417		0.3290	0.3538		.3451	.3554
		2D0	0.3290	0.3417	2U0	0.3290	0.3300	3D0	.3451	.3554
			0.3371	0.3490		0.3366	0.3369		.3533	.3620
			0.3366	0.3369		0.3361	0.3245		.3515	.3487
			0.3290	0.3300		0.3290	0.3180		.3440	.3427

PERFORMANCE GROUPS - CHROMATICITY (T_J = 85 °C) - CONTINUED

ANSI White Bins				
Code	CCT	Bin Code	x	y
0E1	6500 K	1A0	0.3048	0.3207
			0.3130	0.3290
			0.3144	0.3186
			0.3068	0.3113
		1B0	0.3028	0.3304
			0.3115	0.3391
			0.3130	0.3290
			0.3048	0.3207
		1C0	0.3115	0.3391
			0.3205	0.3481
			0.3213	0.3373
			0.3130	0.3290
		1D0	0.3130	0.3290
			0.3213	0.3373
			0.3221	0.3261
			0.3144	0.3186

ANSI White Bins				
Code	CCT	Bin Code	x	y
0E2	5700 K	2A0	0.3215	0.3350
			0.3290	0.3417
			0.3290	0.3300
			0.3222	0.3243
		2B0	0.3207	0.3462
			0.3290	0.3538
			0.3290	0.3417
			0.3215	0.3350
		2C0	0.3290	0.3538
			0.3376	0.3616
			0.3371	0.3490
			0.3290	0.3417
		2D0	0.3290	0.3417
			0.3371	0.3490
			0.3366	0.3369
			0.3290	0.3300

ANSI White Bins				
Code	CCT	Bin Code	x	y
0E3	5000 K	3A0	.3371	.3490
			.3451	.3554
			.3440	.3427
			.3366	.3369
		3B0	.3376	.3616
			.3463	.3687
			.3451	.3554
			.3371	.3490
		3C0	.3463	.3687
			.3551	.3760
			.3533	.3620
			.3451	.3554
		3D0	.3451	.3554
			.3533	.3620
			.3515	.3487
			.3440	.3427

ANSI White Bins				
Code	CCT	Bin Code	x	y
0E4	4500 K	4A0	.3530	.3597
			.3615	.3659
			.3590	.3521
			.3512	.3465
		4B0	.3548	.3736
			.3641	.3804
			.3615	.3659
			.3530	.3597
		4C0	.3641	.3804
			.3736	.3874
			.3702	.3722
			.3615	.3659
		4D0	.3668	.3957
			.3771	.4034
			.3736	.3874
			.3641	.3804

ANSI White Bins				
Code	CCT	Bin Code	x	y
0E5	4000 K	5A0	.3670	.3578
			.3702	.3722
			.3825	.3798
			.3783	.3646
		5B0	.3702	.3722
			.3736	.3874
			.3869	.3958
			.3825	.3798
		5C0	.3825	.3798
			.3869	.3958
			.4006	.4044
			.3950	.3875
		5D0	.3783	.3646
			.3825	.3798
			.3950	.3875
			.3898	.3716

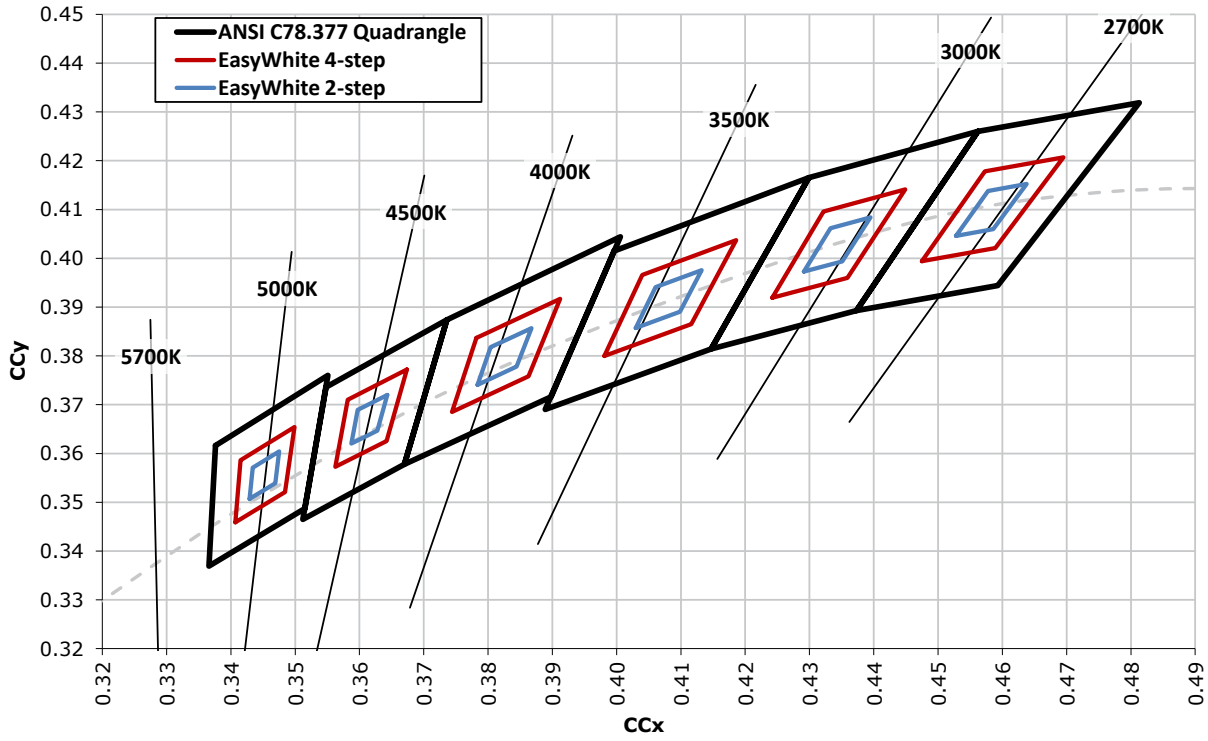
ANSI White Bins				
Code	CCT	Bin Code	x	y
0E6	3500 K	6A0	.3889	.3690
			.3941	.3848
			.4080	.3916
			.4017	.3751
		6B0	.3941	.3848
			.3996	.4015
			.4146	.4089
			.4080	.3916
		6C0	.4080	.3916
			.4146	.4089
			.4299	.4165
			.4221	.3984
		6D0	.4017	.3751
			.4080	.3916
			.4221	.3984
			.4147	.3814

PERFORMANCE GROUPS - CHROMATICITY (T_j = 85 °C) - CONTINUED

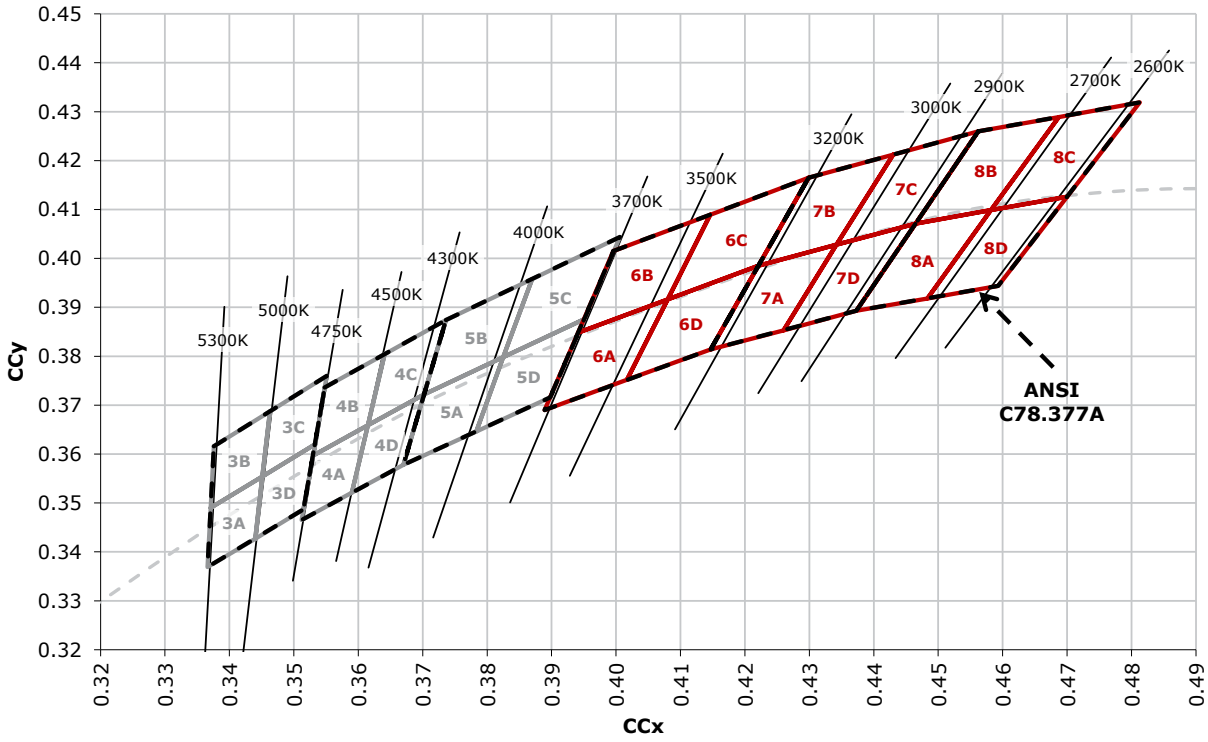
ANSI White Bins				
Code	CCT	Bin Code	x	y
0E7	3000 K	7A0	.4147	.3814
			.4221	.3984
			.4342	.4028
			.4259	.3853
		7B0	.4221	.3984
			.4299	.4165
			.4430	.4212
			.4342	.4028
		7C0	.4342	.4028
			.4430	.4212
			.4562	.4260
			.4465	.4071
		7D0	.4259	.3853
			.4342	.4028
			.4465	.4071
			.4373	.3893

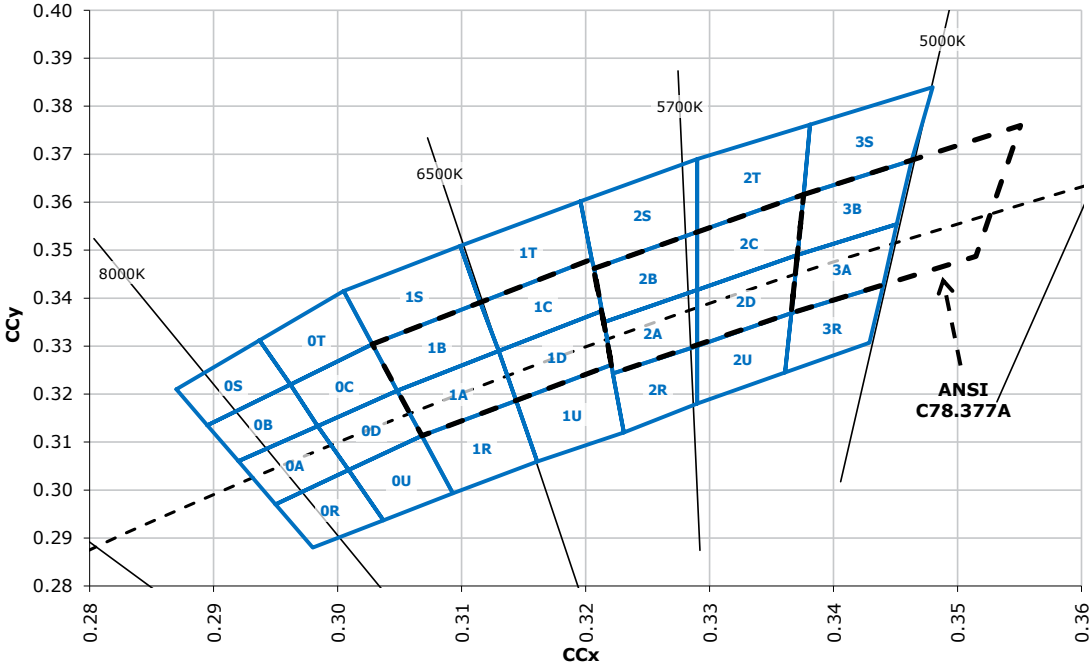
ANSI White Bins				
Code	CCT	Bin Code	x	y
0E8	2700 K	8A0	.4373	.3893
			.4465	.4071
			.4582	.4099
			.4483	.3919
		8B0	.4465	.4071
			.4562	.4260
			.4687	.4289
			.4582	.4099
		8C0	.4582	.4099
			.4687	.4289
			.4813	.4319
			.4700	.4126
		8D0	.4483	.3919
			.4582	.4099
			.4700	.4126
			.4593	.3944

CREE EASYWHITE BINS PLOTTED ON THE 1931 CIE COLOR SPACE (T_j = 85 °C)



CREE ANSI WHITE BINS PLOTTED ON THE 1931 CIE COLOR SPACE (T_J = 85 °C)

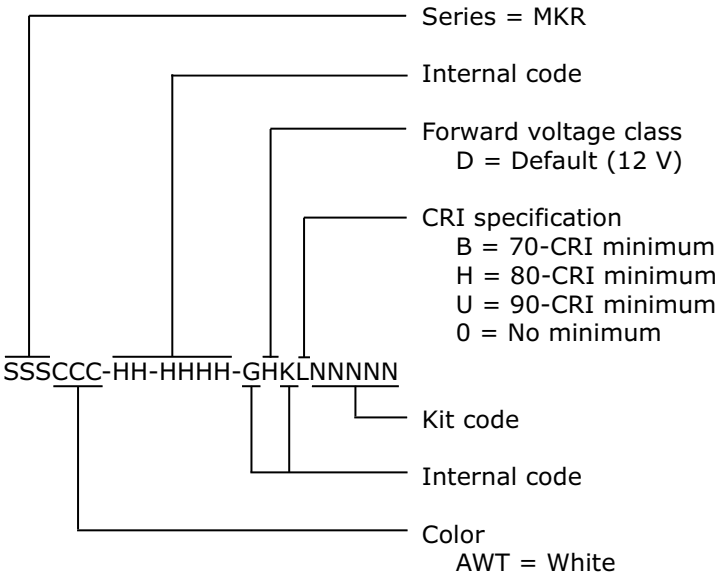




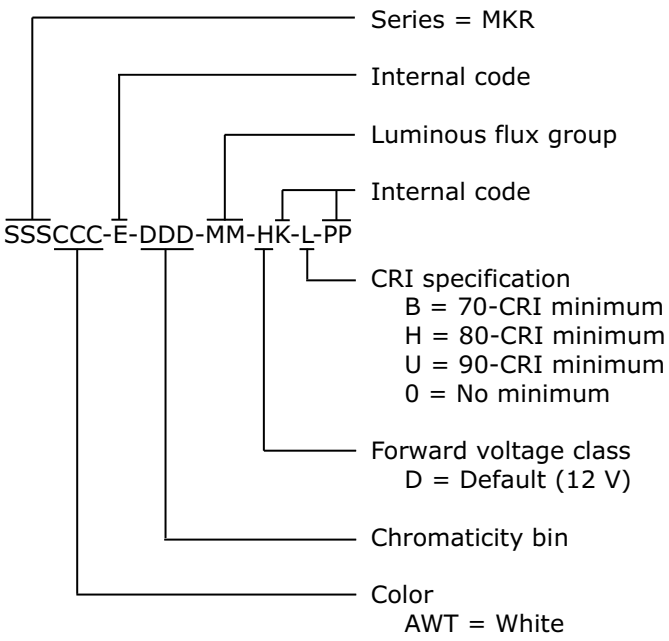
BIN AND ORDER CODE FORMATS

Bin codes and order codes are configured as follows.

Order Code



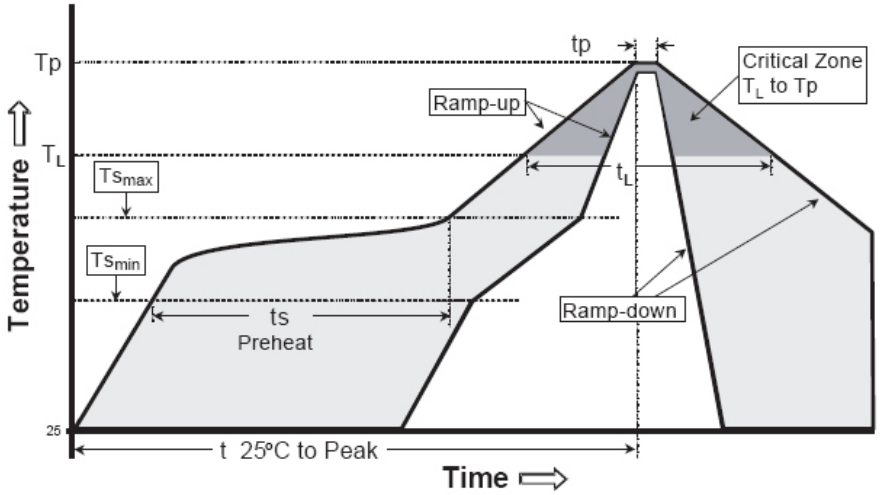
Bin Code



REFLOW SOLDERING CHARACTERISTICS

In testing, Cree has found XLamp MK-R 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 the topside of the package, measured on the package body surface.

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

In testing, Cree has found XLamp MK-R 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.

UL Recognized Component

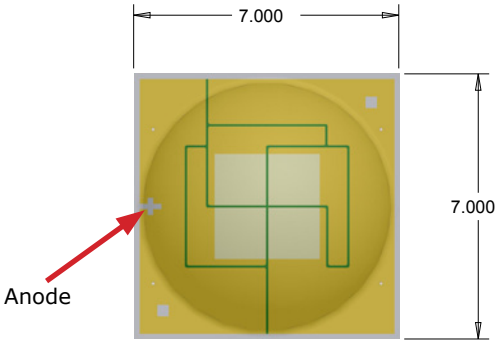
Level 4 enclosure consideration. The LED package or a portion thereof has been investigated as a fire and electrical enclosure per ANSI/UL 8750.

Vision Advisory Claim

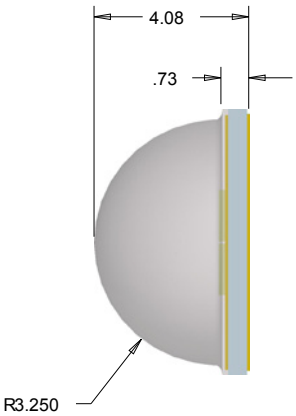
WARNING: Do not look at exposed lamp in operation. Eye injury can result. See the Eye Safety application note at www.cree.com/xlamp_app_notes/led_eye_safety.

MECHANICAL DIMENSIONS

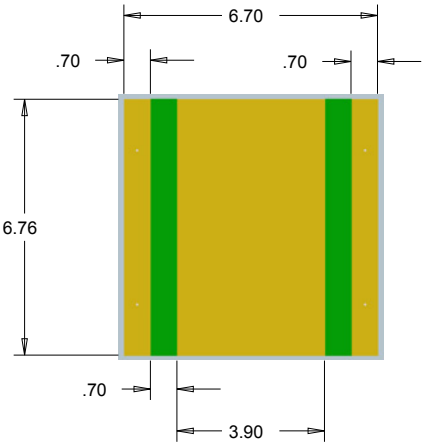
All measurements are ±.13 mm unless otherwise indicated.



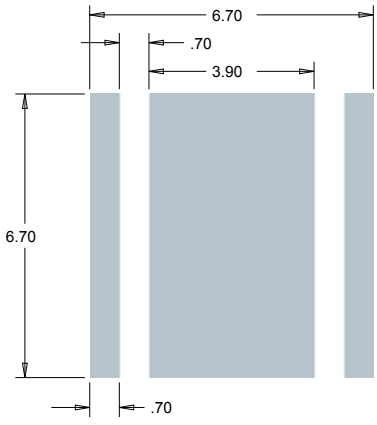
Top View



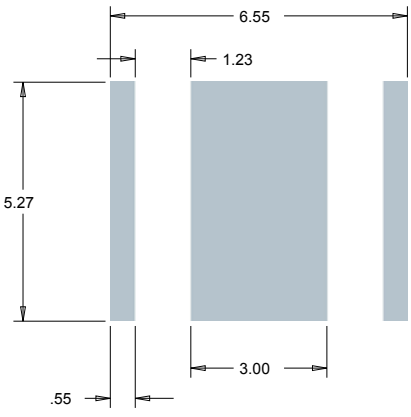
Side View



Bottom View



Recommended PCB Solder Pad

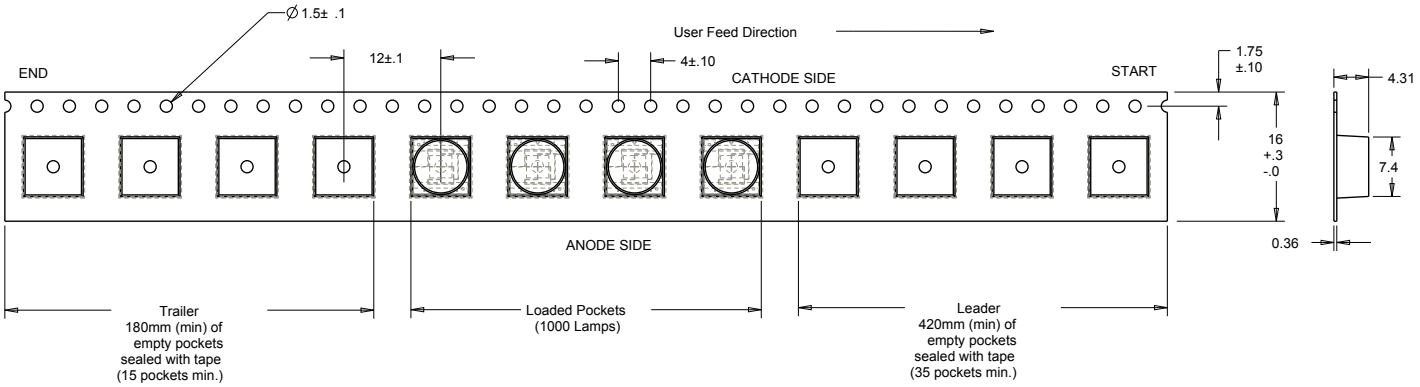


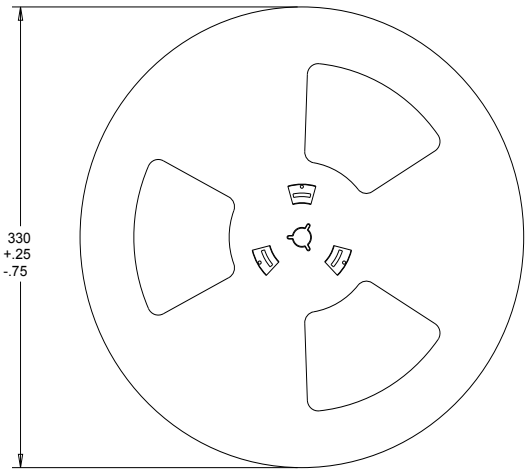
Recommended Stencil Pattern (Shaded Area Is Open)

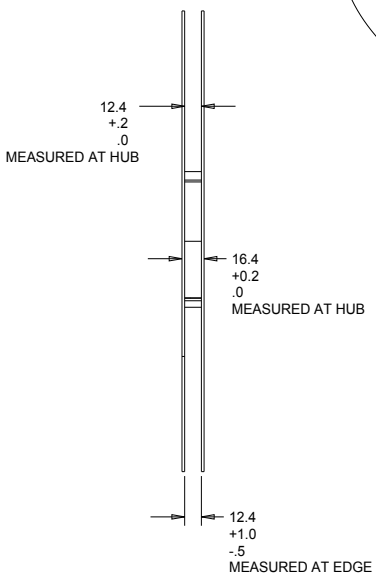
TAPE AND REEL

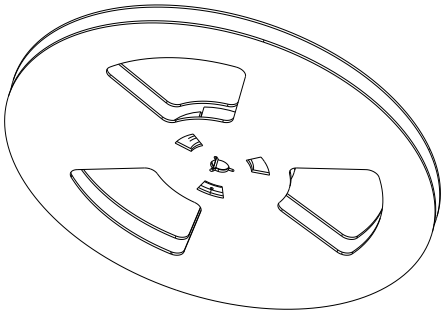
All Cree carrier tapes conform to EIA-481D, Automated Component Handling Systems Standard.

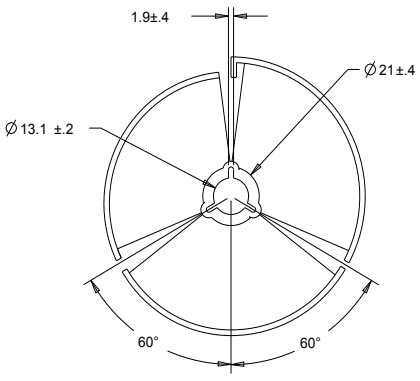
All dimensions in mm.





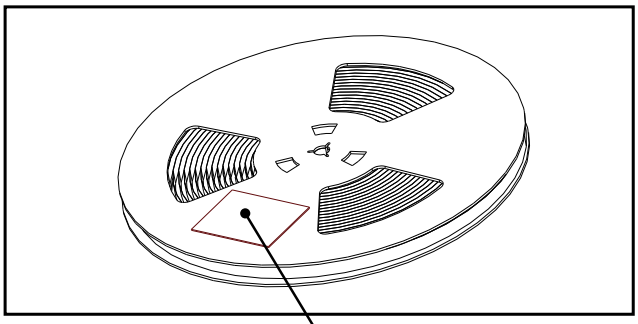




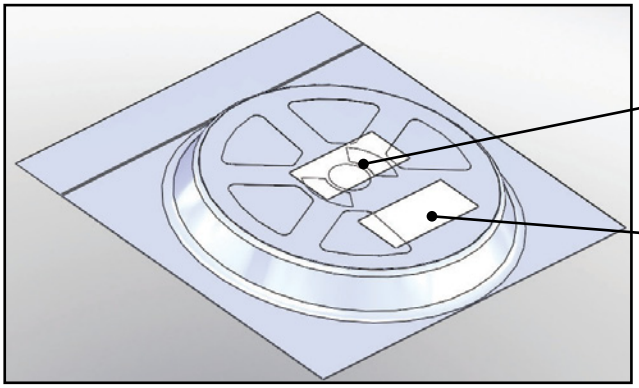


PACKAGING

Unpackaged Reel



Packaged Reel



Boxed Reel