CLD-DS68 REV 9B

Cree® XLamp® CXA3050 LED

PRODUCT DESCRIPTION

The XLamp® CXA3050 LED array expands Cree's family of high-flux, multi-die integrated arrays, offering high performance in an easy-to-use platform. With XLamp LED lighting-class reliability, the CXA3050's uniform emitting surface enables both directional and non-directional lighting applications and luminaire and lamp designs. Available in 2-step, 3-step and 4-step color consistency, and featuring a 23-mm optical source, the CXA3050 brings new levels of flux and efficacy to this form factor.

The CX Family LED Design Guide provides basic information on the requirements to use the CXA3050 LED successfully in luminaire designs.

FEATURES

- Available in 4-step, 3-step and 2-step EasyWhite® bins at 2700 K, 3000 K, 3500 K, 4000 K & 5000 K CCT and 4-step EasyWhite bins at 5700 K & 6500 K CCT
- Available in ANSI white bins at 4000 K, 5000 K, 5700 K & 6500 K CCT
- Available in 70-, 80-, 90- and 93-minimum CRI options
- Forward voltage option: 36-V class
- 85 °C binning and characterization
- Maximum drive current: 2500 mA
- 115° viewing angle, uniform chromaticity profile
- Top-side solder connections
- Thermocouple attach point
- NEMA SSL-3 2011 standard flux bins
- RoHS and REACh compliant
- UL® recognized component (E349212)

TABLE OF CONTENTS

Characteristics 2
Operating Limits 2
Flux Characteristics, EasyWhite® Order Codes and Bins 3
Flux Characteristics, ANSI White Order Codes and Bins 6
Relative Spectral Power Distribution 7
Electrical Characteristics 7
Relative Luminous Flux 8
Typical Spatial Distribution 9
Performance Groups - Brightness 9
Performance Groups - Chromaticity 10
Cree EasyWhite® Bins Plotted on the 1931 CIE Color Space 13
Cree ANSI White Bins Plotted on the 1931 CIE Color Space 13
Bin and Order Code Formats 14
Mechanical Dimensions 14
Thermal Design 15
Notes 16
Packaging 17

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CHARACTERISTICS

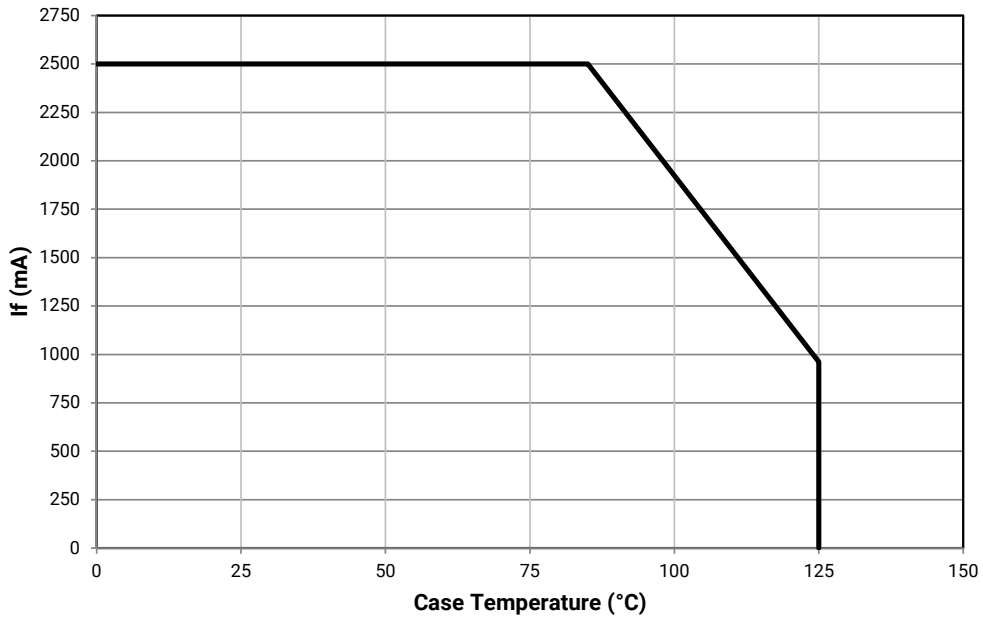
Characteristics	Unit	Minimum	Typical	Maximum
Viewing angle (FWHM)	degrees		115	
ESD withstand voltage (HBM per Mil-Std-883D)	V			8000
DC forward current	mA			2500*
Reverse current	mA			0.1
Forward voltage (@ 1400 mA, T_j = 85 °C)	V		36	
Forward voltage (@ 1400 mA, T_j = 25 °C)	V			42

* Refer to the Operating Limits section.

OPERATING LIMITS

The maximum current rating of the CXA3050 depends on the case temperature (Tc) when the LED has reached thermal equilibrium under steady-state operation. The graph shown below assumes that the system design employs good thermal management (thermal interface material and heat sink) and may vary when poor thermal management is employed. Please refer to the Mechanical Dimensions section on page 14 for the location of the Tc measurement point.

Another important factor in good thermal management is the temperature of the Light Emitting Surface (LES). Cree recommends a maximum LES temperature of 135 °C to ensure optimal LED lifetime. Please refer to the Thermal Design section on page 15 for more information on LES temperature measurement.



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FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS (I_F = 1400 mA, T_J = 85 °C)

The following table provides order codes for XLamp CXA3050 LEDs. For a complete description of the order code nomenclature, please see the Bin and Order Code Formats section (page 14).

Nominal CCT	CRI		Minimum Luminous Flux			2-Step		3-Step		4-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C*	Group	Order Code	Group	Order Code	Group	Order Code
6500 K	70	75	X4	6010	6773					65F	CXA3050-0000-000N00X465F
			Y2	6430	7246						CXA3050-0000-000N00Y265F
			Y4	6910	7485						CXA3050-0000-000N00Y465F
	80	---	X2	5590	6299					65F	CXA3050-0000-000N0HX265F
			X4	6010	6773						CXA3050-0000-000N0HX465F
			Y2	6430	7246						CXA3050-0000-000N0HY265F
5700 K	70	75	X4	6010	6773					57F	CXA3050-0000-000N00X457F
			Y2	6430	7246						CXA3050-0000-000N00Y257F
			Y4	6910	7485						CXA3050-0000-000N00Y457F
	80	---	X2	5590	6299					57F	CXA3050-0000-000N0HX257F
			X4	6010	6773						CXA3050-0000-000N0HX457F
			Y2	6430	7246						CXA3050-0000-000N0HY257F
5000 K	70	75	X4	6010	6773	50H	CXA3050-0000-000N00X450H			50F	CXA3050-0000-000N00X450F
			Y2	6430	7246		CXA3050-0000-000N00Y250H				CXA3050-0000-000N00Y250F
			Y4	6910	7485		CXA3050-0000-000N00Y450H				CXA3050-0000-000N00Y450F
	80	---	X2	5590	6299	50H	CXA3050-0000-000N0HX250H			50F	CXA3050-0000-000N0HX250F
			X4	6010	6773		CXA3050-0000-000N0HX450H	50G	CXA3050-0000-000N0HX450G		CXA3050-0000-000N0HX450F
			Y2	6430	7246		CXA3050-0000-000N0HY250H		CXA3050-0000-000N0HY250G		CXA3050-0000-000N0HY250F
	90	95	W2	4860	5477	50H	CXA3050-0000-000N0UW250H	50G		50F	CXA3050-0000-000N0UW250F
			W4	5225	5888		CXA3050-0000-000N0UW450H		CXA3050-0000-000N0UW450G		CXA3050-0000-000N0UW450F
			X2	5590	6299		CXA3050-0000-000N0UX250H		CXA3050-0000-000N0UX250G		CXA3050-0000-000N0UX250F

Notes

- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and a tolerance of ±2 on CRI measurements. See the Measurements section (page 16).
- Cree XLamp CXA3050 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.

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FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS (I_F = 1400 mA, T_J = 85 °C) - CONTINUED

Nominal CCT	CRI		Minimum Luminous Flux			2-Step		3-Step		4-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C*	Group	Order Code	Group	Order Code	Group	Order Code
4000 K	70	75	X4	6010	6773	40H	CXA3050-0000-000N00X440H			40F	CXA3050-0000-000N00X440F
			Y2	6430	7246		CXA3050-0000-000N00Y240H				CXA3050-0000-000N00Y240F
			Y4	6910	7485		CXA3050-0000-000N00Y440H				CXA3050-0000-000N00Y440F
	80	---	X2	5590	6299	40H	CXA3050-0000-000N0HX240H	40G		40F	CXA3050-0000-000N0HX240F
			X4	6010	6773		CXA3050-0000-000N0HX440H		CXA3050-0000-000N0HX440G		CXA3050-0000-000N0HX440F
			Y2	6430	7246		CXA3050-0000-000N0HY240H		CXA3050-0000-000N0HY240G		CXA3050-0000-000N0HY240F
	90	95	V4	4545	5122	40H	CXA3050-0000-000N0UV440H	40G		40F	CXA3050-0000-000N0UV440F
			W2	4860	5477		CXA3050-0000-000N0UW240H		CXA3050-0000-000N0UW240G		CXA3050-0000-000N0UW240F
			W4	5225	5888		CXA3050-0000-000N0UW440H		CXA3050-0000-000N0UW440G		CXA3050-0000-000N0UW440F
3500 K	80	---	X2	5590	6299	35H	CXA3050-0000-000N00X235H	35G		35F	CXA3050-0000-000N00X235F
			X4	6010	6773		CXA3050-0000-000N00X435H		CXA3050-0000-000N00X435G		CXA3050-0000-000N00X435F
			Y2	6430	7246		CXA3050-0000-000N00Y235H		CXA3050-0000-000N00Y235G		CXA3050-0000-000N00Y235F
	93	95	V2	4230	4767	35H	CXA3050-0000-000N0YV235H	35G	CXA3050-0000-000N0YV235G	35F	CXA3050-0000-000N0YV235F
			V4	4545	5122		CXA3050-0000-000N0YV435H		CXA3050-0000-000N0YV435G		CXA3050-0000-000N0YV435F
			W2	4860	5477		CXA3050-0000-000N0YW235H		CXA3050-0000-000N0YW235G		CXA3050-0000-000N0YW235F
3000 K	80	---	W4	5225	5888	30H	CXA3050-0000-000N00W430H	30G		30F	CXA3050-0000-000N00W430F
			X2	5590	6299		CXA3050-0000-000N00X230H		CXA3050-0000-000N00X230G		CXA3050-0000-000N00X230F
			X4	6010	6773		CXA3050-0000-000N00X430H		CXA3050-0000-000N00X430G		CXA3050-0000-000N00X430F
	93	95	U4	3955	4469	30H	CXA3050-0000-000N0YU430H	30G	CXA3050-0000-000N0YU430G	30F	CXA3050-0000-000N0YU430F
			V2	4230	4767		CXA3050-0000-000N0YV230H		CXA3050-0000-000N0YV230G		CXA3050-0000-000N0YV230F
			V4	4545	5122		CXA3050-0000-000N0YV430H		CXA3050-0000-000N0YV430G		CXA3050-0000-000N0YV430F

Notes

- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and a tolerance of ±2 on CRI measurements. See the Measurements section (page 16).
- Cree XLamp CXA3050 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.

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FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS (I_F = 1400 mA, T_J = 85 °C) - CONTINUED

Nominal CCT	CRI		Minimum Luminous Flux			2-Step		3-Step		4-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C*	Group	Order Code	Group	Order Code	Group	Order Code
2700 K	80	---	W2	4860	5477	27H	CXA3050-0000-000N00W227H	27G		27F	CXA3050-0000-000N00W227F
			W4	5225	5888		CXA3050-0000-000N00W427H		CXA3050-0000-000N00W427G		CXA3050-0000-000N00W427F
			X2	5590	6299		CXA3050-0000-000N00X227H		CXA3050-0000-000N00X227G		CXA3050-0000-000N00X227F
	93	95	U2	3680	4158	27H	CXA3050-0000-000N0YU227H	27G	CXA3050-0000-000N0YU227G	27F	CXA3050-0000-000N0YU227F
			U4	3955	4469		CXA3050-0000-000N0YU427H		CXA3050-0000-000N0YU427G		CXA3050-0000-000N0YU427F
			V2	4230	4767		CXA3050-0000-000N0YV227H		CXA3050-0000-000N0YV227G		CXA3050-0000-000N0YV227F

Notes

- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and a tolerance of ±2 on CRI measurements. See the Measurements section (page 16).
- Cree XLamp CXA3050 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.

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FLUX CHARACTERISTICS, ANSI WHITE ORDER CODES AND BINS (I_F = 1400 mA, T_J = 85 °C)

The following table provides order codes for XLamp CXA3050 LEDs. For a complete description of the order code nomenclature, please rsee the Bin and Order Code Formats section (page 14).

Nominal CCT	CRI		Minimum Luminous Flux			Chromaticity Regions	Order Code
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C*		
6500 K	70	75	X4	6010	6773	1A0, 1B0, 1C0, 1D0, 65F	CXA3050-0000-000N00X40E1
			Y2	6430	7246		CXA3050-0000-000N00Y20E1
			Y4	6910	7485		CXA3050-0000-000N00Y40E1
	80	---	X2	5590	6299	1A0, 1B0, 1C0, 1D0, 65F	CXA3050-0000-000N0HX20E1
			X4	6010	6773		CXA3050-0000-000N0HX40E1
			Y2	6430	7246		CXA3050-0000-000N0HY20E1
5700 K	70	75	X4	6010	6773	2A0, 2B0, 2C0, 2D0, 57F	CXA3050-0000-000N00X40E2
			Y2	6430	7246		CXA3050-0000-000N00Y20E2
			Y4	6910	7485		CXA3050-0000-000N00Y40E2
	80	---	X2	5590	6299	2A0, 2B0, 2C0, 2D0, 57F	CXA3050-0000-000N0HX20E2
			X4	6010	6773		CXA3050-0000-000N0HX40E2
			Y2	6430	7246		CXA3050-0000-000N0HY20E2
5000 K	70	75	X4	6010	6773	3A0, 3B0, 3C0, 3D0, 50F	CXA3050-0000-000N00X40E3
			Y2	6430	7246		CXA3050-0000-000N00Y20E3
			Y4	6910	7485		CXA3050-0000-000N00Y40E3
	80	---	X2	5590	6299	3A0, 3B0, 3C0, 3D0, 50F	CXA3050-0000-000N0HX20E3
			X4	6010	6773		CXA3050-0000-000N0HX40E3
			Y2	6430	7246		CXA3050-0000-000N0HY20E3
4000 K	70	75	X4	6010	6773	5A0, 5B0, 5C0, 5D0, 40F	CXA3050-0000-000N00X40E5
			Y2	6430	7246		CXA3050-0000-000N00Y20E5
			Y4	6910	7485		CXA3050-0000-000N00Y40E5

Notes

- Cree maintains a tolerance of ±7% on flux and power measurements, ±0.005 on chromaticity (CCx, CCy) measurements and a tolerance of ±2 on CRI measurements. See the Measurements section (page 16).
- Cree XLamp CXA3050 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.

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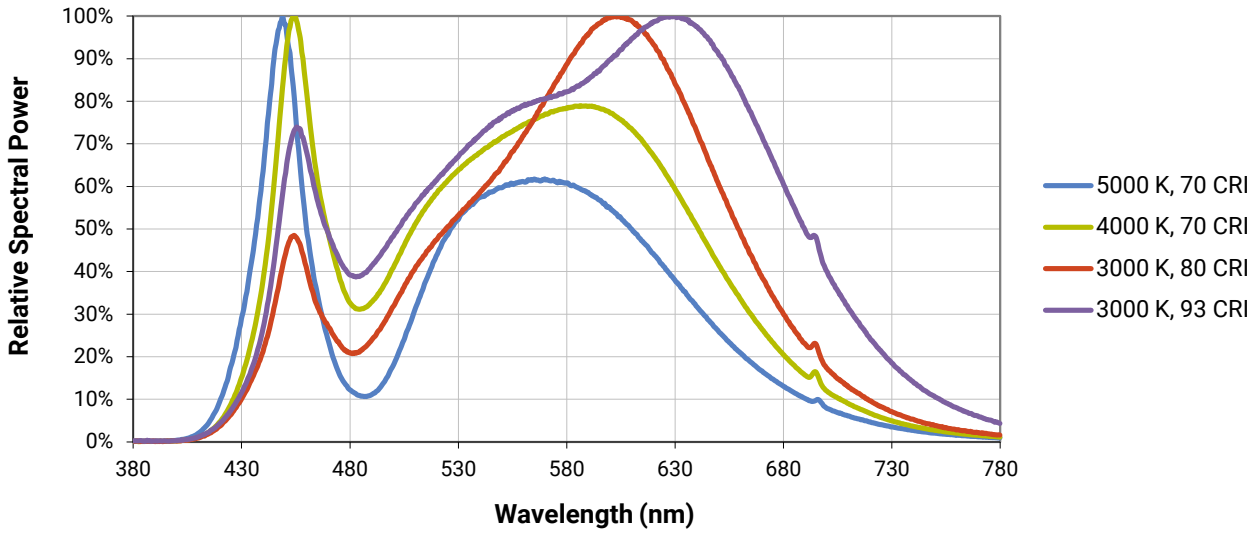
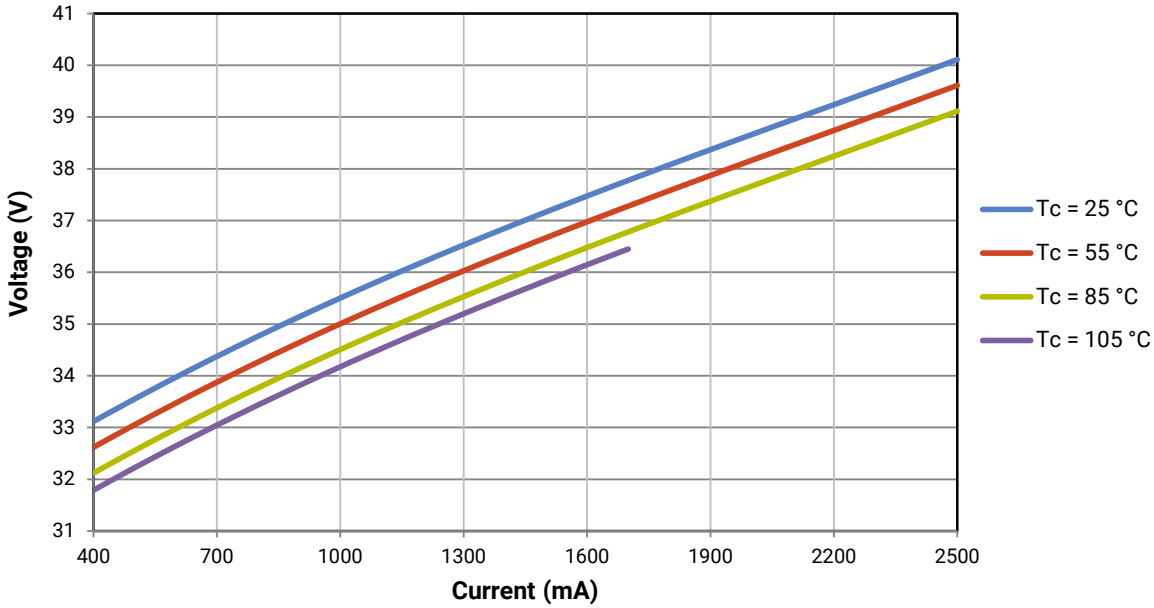
RELATIVE SPECTRAL POWER DISTRIBUTION

The following graph is the result of a series of pulsed measurements at 1400 mA and T_J = 85 °C.



ELECTRICAL CHARACTERISTICS

The following graph is the result of a series of steady-state measurements.



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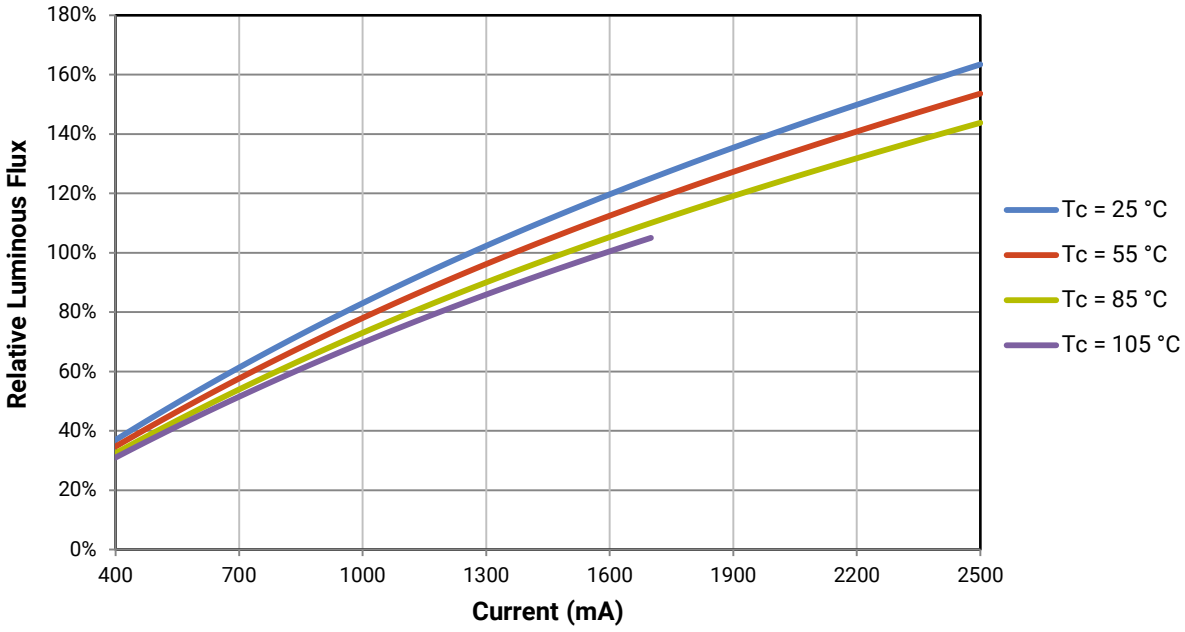
RELATIVE LUMINOUS FLUX

The relative luminous flux values provided below are the ratio of:

- Measurements of CXA3050 at steady-state operation at the given conditions, divided by
- Flux measured during binning, which is a pulsed measurement at 1400 mA at T_J = 85 °C.

For example, at steady-state operation of Tc = 25 °C, I_F = 1600 mA, the relative luminous flux ratio is 120% in the chart below. A CXA3050 LED that measures 6000 lm during binning will deliver 7200 lm (6000 * 1.2) at steady-state operation of Tc = 25 °C, I_F = 1600 mA.



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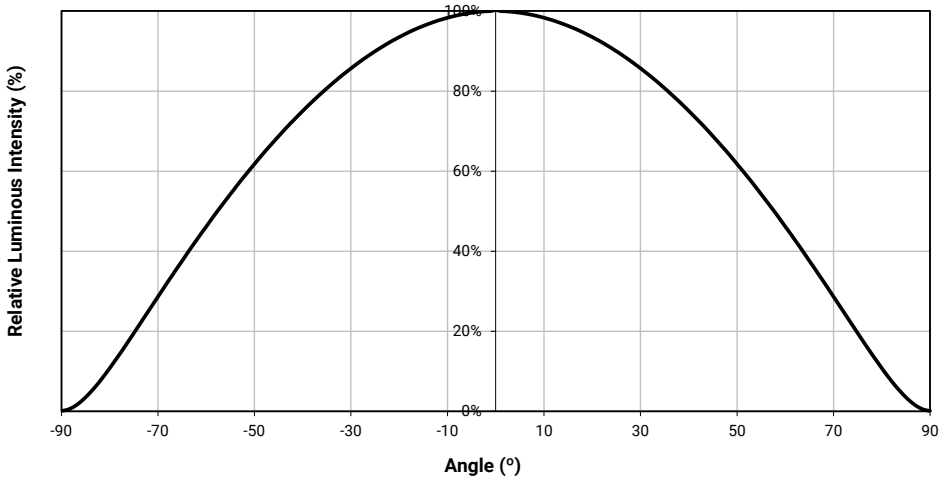
TYPICAL SPATIAL DISTRIBUTION



PERFORMANCE GROUPS - BRIGHTNESS (I_F = 1400 mA, T_J = 85 °C)

XLamp CXA3050 LEDs are tested for luminous flux and placed into one of the following bins.

Group Code	Minimum Luminous Flux	Maximum Luminous Flux
U2	3680	3955
U4	3955	4230
V2	4230	4545
V4	4545	4860
W2	4860	5225
W4	5225	5590
X2	5590	6010
X4	6010	6430
Y2	6430	6910
Y4	6910	7390
Z2	7390	7945

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PERFORMANCE GROUPS - CHROMATICITY (T_J = 85 °C)

XLamp CXA3050 LEDs are tested for chromaticity and placed into one of the regions defined by the following bounding coordinates.

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
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

EasyWhite Color Temperatures – 3-Step Ellipse						
Bin Code	CCT	Center Point		Major Axis	Minor Axis	Rotation Angle (°)
		x	y	a	b	
50G	5000 K	0.3447	0.3553	0.00840	0.00312	65.0
40G	4000 K	0.3818	0.3797	0.00939	0.00402	53.7
35G	3500 K	0.4073	0.3917	0.00927	0.00414	54.0
30G	3000 K	0.4338	0.4030	0.00834	0.00408	53.2
27G	2700 K	0.4577	0.4099	0.00834	0.00420	48.5

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

EasyWhite Color Temperatures – 4-Step			
Code	**CCT**	**x**	**y**
65F	6500 K	0.3097	0.3196
		0.3079	0.3297
		0.3164	0.3382
		0.3176	0.3275
57F	5700 K	0.3253	0.3325
		0.3249	0.3439
		0.3331	0.3514
		0.3330	0.3393
50F	5000 K	0.3407	0.3459
		0.3415	0.3586
		0.3499	0.3654
		0.3484	0.3521
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

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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
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

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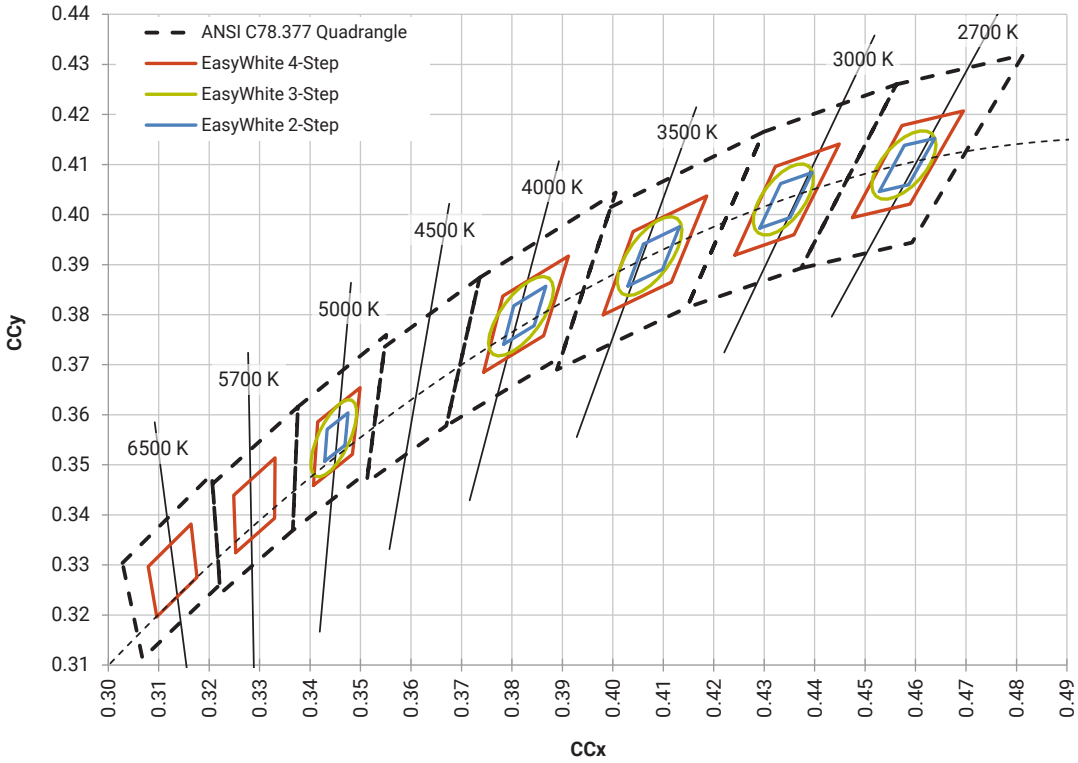
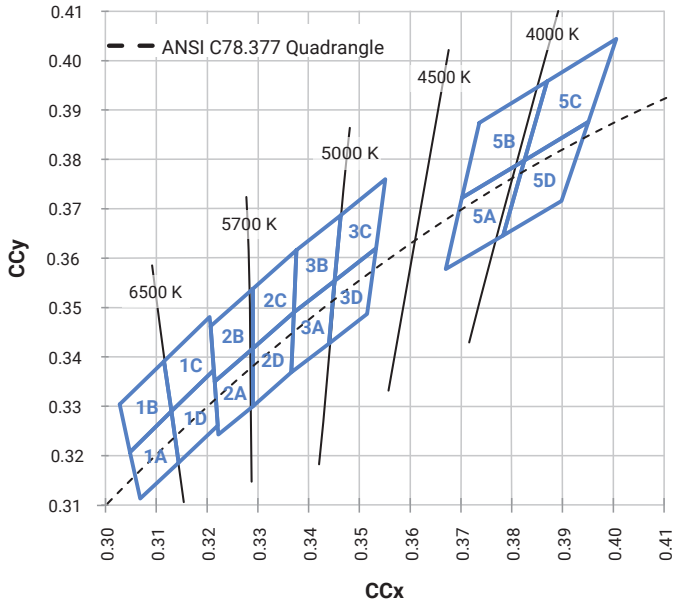
CREE EASYWHITE® BINS PLOTTED ON THE 1931 CIE COLOR SPACE (T_J = 85 °C)



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



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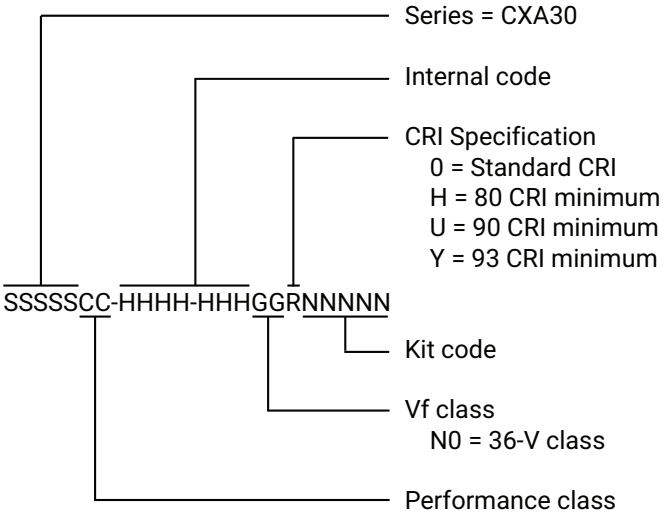
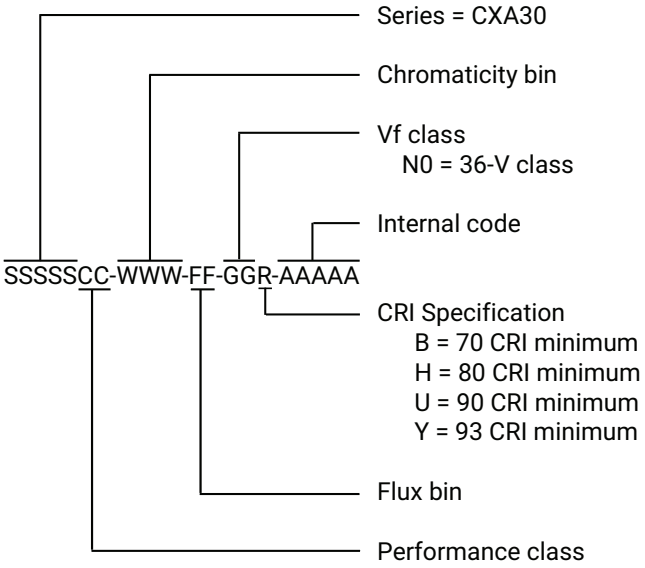
BIN AND ORDER CODE FORMATS

Bin codes and order codes are configured as follows:

Order Code



Bin Code



MECHANICAL DIMENSIONS

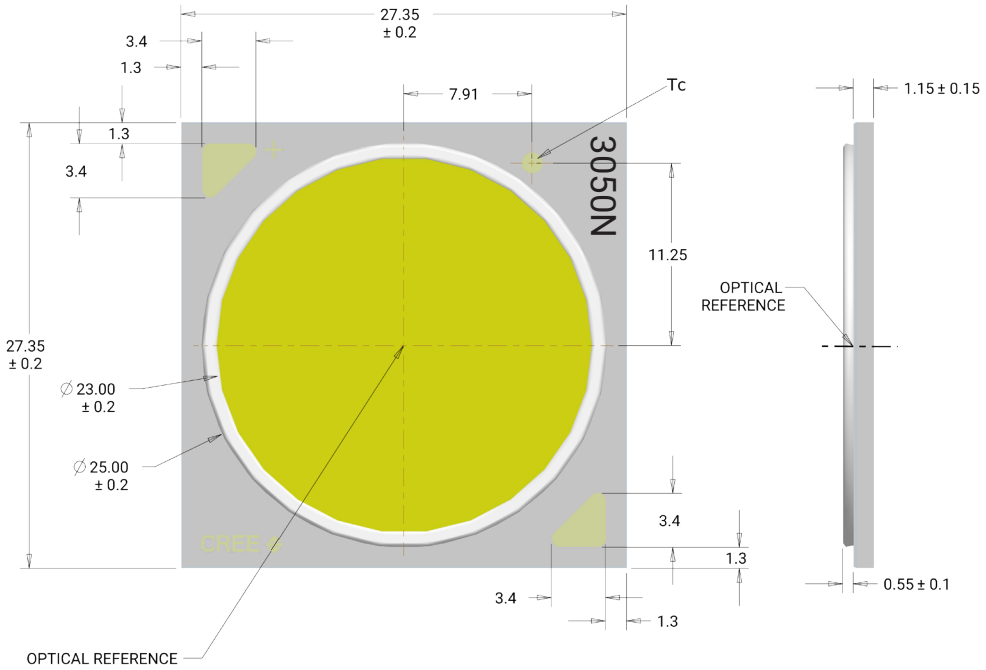
Dimensions are in mm.

Tolerances unless otherwise specified: ±.13

x° ±1°

Meaning of 3050N

3050N = 36-V CXA3050



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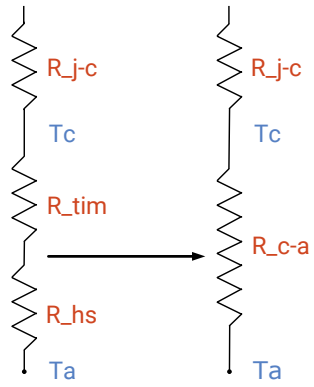
THERMAL DESIGN

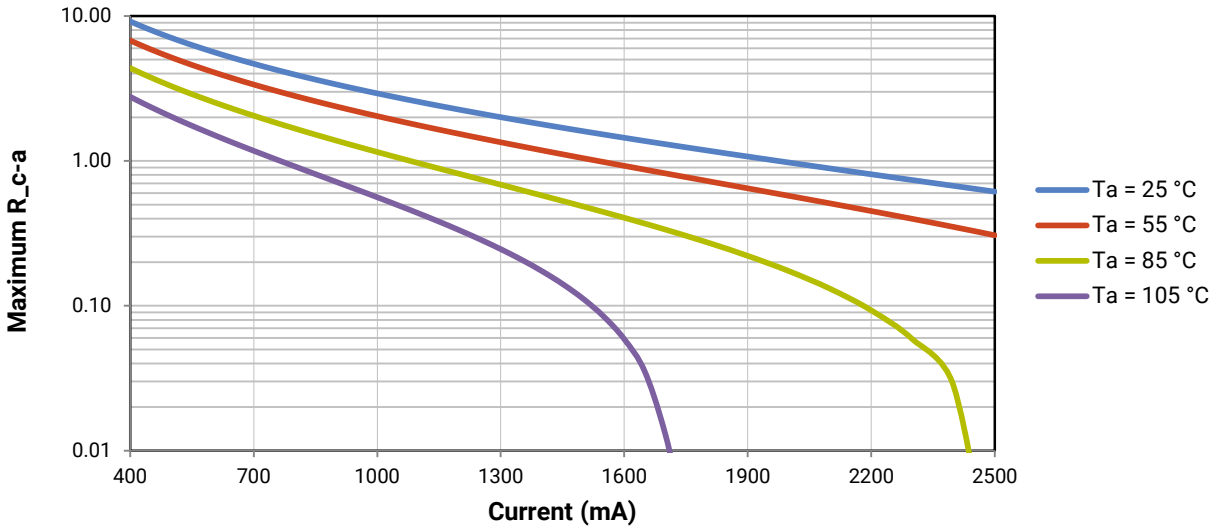
The CXA family of LED arrays can include over a hundred different LED die inside one package, and thus over a hundred different junction temperatures (T_J). Cree has intentionally removed junction-temperature-based operating limits and replaced the commonplace maximum T_J calculations with maximum ratings based on forward current (I_F) and case temperature (Tc). No additional calculations are required to ensure that the CXA LED is being operated within its designed limits. LES temperature measurement provides additional verification of good thermal design. Please refer to page 2 for the Operating Limit specifications.

There is no need to calculate for T_J inside the package, as the thermal management design process, specifically from T_{SP} to ambient (T_a), remains identical to any other LED component. For more information on thermal management of Cree XLamp LEDs, please refer to the Thermal Management application note. For CXA soldering recommendations and more information on thermal interface materials (TIM), LES temperature measurement, and connection methods, please refer to the Cree XLamp CX Family LEDs soldering and handling document. The CX Family LED Design Guide provides basic information on the requirements to use Cree XLamp CXA LEDs successfully in luminaire designs.

To keep the CXA3050 LED at or below the maximum rated Tc, the case to ambient temperature thermal resistance (R_c-a) must be at or below the maximum R_c-a value shown on the following graph, depending on the operating environment. The y-axis in the graph is a base 10 logarithmic scale.

As the figure at right shows, the R_c-a value is the sum of the thermal resistance of the TIM (R_tim) plus the thermal resistance of the heat sink (R_hs).





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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.

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.

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.

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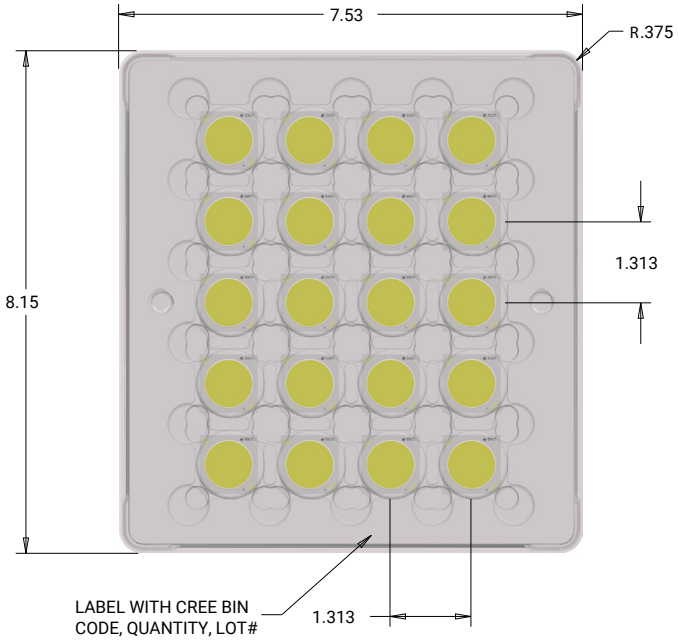
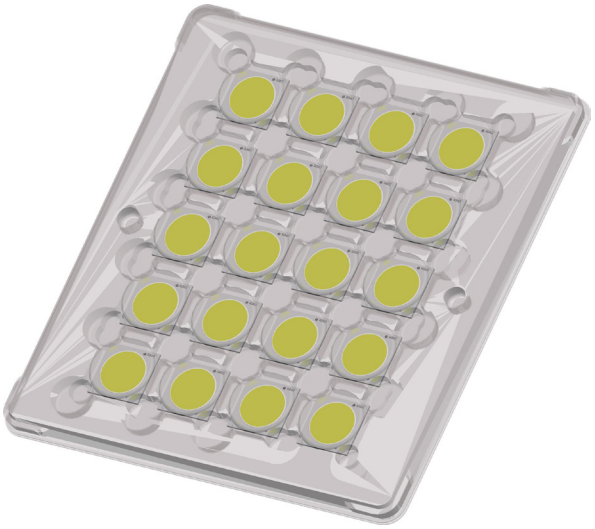
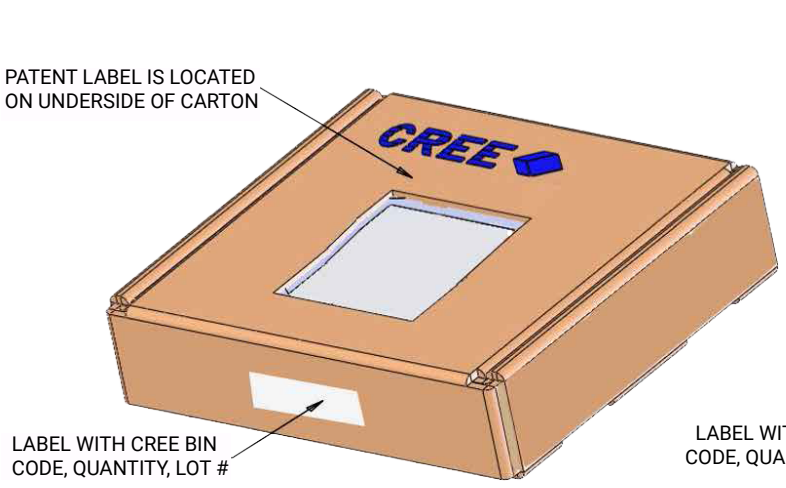
PACKAGING

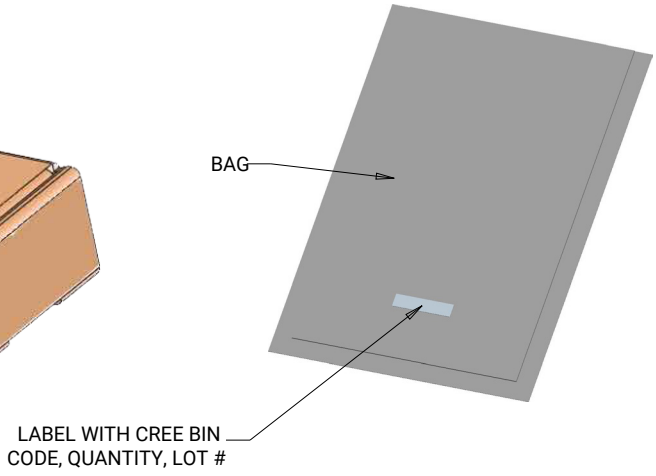
Cree CXA3050 LEDs are packaged in trays of 20. Five trays are sealed in an anti-static bag and placed inside a carton, for a total of 100 LEDs per carton. Each carton contains 100 LEDs from the same performance bin.

Dimensions are in inches.
Tolerances: ±.13
x° ±1°









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Стандарт Электрон Связь

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Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

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С нами вы становитесь еще успешнее!

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