

Cree® XLamp® CXA1816 LED



PRODUCT DESCRIPTION

The XLamp® CXA1816 LED array expands Cree's family of high-flux, multi-die arrays in a smaller, easy-to-use platform. With XLamp LED lighting-class reliability, the CXA1816's small, uniform emitting surface enables both directional and non-directional lighting applications including lamp retrofit and luminaire designs. Available in 2-step, 3-step and 4-step color consistency, and featuring a 12-mm optical source, the CXA1816 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 CXA1816 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: 900 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)

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CHARACTERISTICS

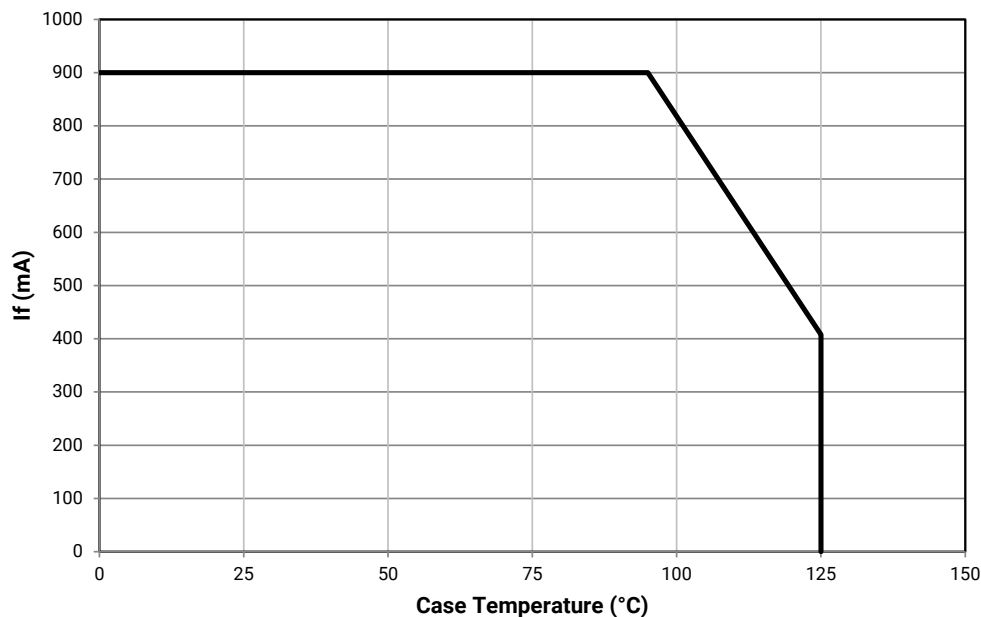
Characteristics	Unit	Minimum	Typical	Maximum
Viewing angle (FWHM)	degrees		115	
ESD withstand voltage (HBM per Mil-Std-883D)	V			8000
DC forward current	mA			900*
Reverse current	mA			0.1
Forward voltage (450 mA, 85 °C)	V		36.2	
Forward voltage (450 mA, 25 °C)	V			42

* Refer to the Operating Limits section.

OPERATING LIMITS

The maximum current rating of the CXA1816 depends on the case temperature (T_c) 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 T_c 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.



FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS ($I_F = 450 \text{ mA}$, $T_J = 85^\circ\text{C}$)

The following table provides order codes for XLamp CXA1816 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	P2	1830	2028					65F	CXA1816-0000-000N00P265F
			P4	1965	2177						CXA1816-0000-000N00P465F
			Q2	2100	2327						CXA1816-0000-000N00Q265F
	80	—	P2	1830	2028					65F	CXA1816-0000-000N0HP265F
			P4	1965	2177						CXA1816-0000-000N0HP465F
			Q2	2100	2327						CXA1816-0000-000N0HQ265F
5700 K	70	75	P4	1965	2177					57F	CXA1816-0000-000N00P457F
			Q2	2100	2327						CXA1816-0000-000N00Q257F
			Q4	2260	2542						CXA1816-0000-000N00Q457F
	80	—	P2	1830	2028					57F	CXA1816-0000-000N0HP257F
			P4	1965	2177						CXA1816-0000-000N0HP457F
			Q2	2100	2327						CXA1816-0000-000N0HQ257F
5000 K	70	75	P4	1965	2177	50H	CXA1816-0000-000N00P450H			50F	CXA1816-0000-000N00P450F
			Q2	2100	2327		CXA1816-0000-000N00Q250H				CXA1816-0000-000N00Q250F
			Q4	2260	2542		CXA1816-0000-000N00Q450H				CXA1816-0000-000N00Q450F
	80	—	P2	1830	2028	50H	CXA1816-0000-000N0HP250H	50G		50F	CXA1816-0000-000N0HP250F
			P4	1965	2177		CXA1816-0000-000N0HP450H		CXA1816-0000-000N0HP450G		CXA1816-0000-000N0HP450F
			Q2	2100	2327		CXA1816-0000-000N0HQ250H		CXA1816-0000-000N0HQ250G		CXA1816-0000-000N0HQ250F
	90	95	M4	1485	1645	50H	CXA1816-0000-000N0UM450H	50G	CXA1816-0000-000N0UM450G	50F	CXA1816-0000-000N0UM450F
			N2	1590	1762		CXA1816-0000-000N0UN250H		CXA1816-0000-000N0UN250G		CXA1816-0000-000N0UN250F
			N4	1710	1895		CXA1816-0000-000N0UN450H		CXA1816-0000-000N0UN450G		CXA1816-0000-000N0UN450F

- Notes
- Cree maintains a tolerance of $\pm 7\%$ 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 CXA1304 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.

FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS ($I_F = 450 \text{ mA}$, $T_J = 85^\circ\text{C}$) - 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	P2	1830	2028	40H	CXA1816-0000-000N00P240H			40F	CXA1816-0000-000N00P240F
			P4	1965	2177		CXA1816-0000-000N00P440H				CXA1816-0000-000N00P440F
			Q2	2100	2327		CXA1816-0000-000N00Q240H				CXA1816-0000-000N00Q240F
	80	---	N4	1710	1895	40H	CXA1816-0000-000N0HN440H	40G		40F	CXA1816-0000-000N0HN440F
			P2	1830	2028		CXA1816-0000-000N0HP240H				CXA1816-0000-000N0HP240F
			P4	1965	2177		CXA1816-0000-000N0HP440H				CXA1816-0000-000N0HP440F
	90	95	M2	1380	1537	40H	CXA1816-0000-000N0UM240H	40G		40F	CXA1816-0000-000N0UM240F
			M4	1485	1645		CXA1816-0000-000N0UM440H				CXA1816-0000-000N0UM440F
			N2	1590	1762		CXA1816-0000-000N0UN240H				CXA1816-0000-000N0UN240F
3500 K	80	---	N4	1710	1895	35H	CXA1816-0000-000N00N435H	35G		35F	CXA1816-0000-000N00N435F
			P2	1830	2028		CXA1816-0000-000N00P235H				CXA1816-0000-000N00P235F
			P4	1965	2177		CXA1816-0000-000N00P435H				CXA1816-0000-000N00P435F
	93	95	K4	1290	1437	35H	CXA1816-0000-000N0YK435H	35G		35F	CXA1816-0000-000N0YK435F
			M2	1380	1537		CXA1816-0000-000N0YM235H				CXA1816-0000-000N0YM235F
			M4	1485	1645		CXA1816-0000-000N0YM435H				CXA1816-0000-000N0YM435F
3000 K	80	---	N4	1710	1895	30H	CXA1816-0000-000N00N430H	30G		30F	CXA1816-0000-000N00N430F
			P2	1830	2028		CXA1816-0000-000N00P230H				CXA1816-0000-000N00P230F
			P4	1965	2177		CXA1816-0000-000N00P430H				CXA1816-0000-000N00P430F
	93	95	K4	1290	1437	30H	CXA1816-0000-000N0YK430H	30G		30F	CXA1816-0000-000N0YK430F
			M2	1380	1537		CXA1816-0000-000N0YM230H				CXA1816-0000-000N0YM230F
			M4	1485	1645		CXA1816-0000-000N0YM430H				CXA1816-0000-000N0YM430F

Notes

- Cree maintains a tolerance of $\pm 7\%$ 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 CXA1304 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.

FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS ($I_F = 450 \text{ mA}$, $T_J = 85 \text{ }^\circ\text{C}$) - 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	---	N2	1590	1762	27H	CXA1816-0000-000N00N227H	27G		27F	CXA1816-0000-000N00N227F
			N4	1710	1895		CXA1816-0000-000N00N427H		CXA1816-0000-000N00N427G		CXA1816-0000-000N00N427F
			P2	1830	2028		CXA1816-0000-000N00P227H		CXA1816-0000-000N00P227G		CXA1816-0000-000N00P227F
	93	95	K2	1200	1337	27H	CXA1816-0000-000N0YK227H	27G		27F	CXA1816-0000-000N0YK227F
			K4	1290	1437		CXA1816-0000-000N0YK427H		CXA1816-0000-000N0YK427G		CXA1816-0000-000N0YK427F
			M2	1380	1537		CXA1816-0000-000N0YM227H		CXA1816-0000-000N0YM227G		CXA1816-0000-000N0YM227F

- Notes
- Cree maintains a tolerance of $\pm 7\%$ 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 CXA1304 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.

FLUX CHARACTERISTICS, ANSI WHITE ORDER CODES AND BINS ($I_F = 450 \text{ mA}$, $T_J = 85^\circ \text{C}$)

The following table provides order codes for XLamp CXA1816 LEDs. For a complete description of the order code nomenclature, please see the Bin and Order Code Formats section (page 14).

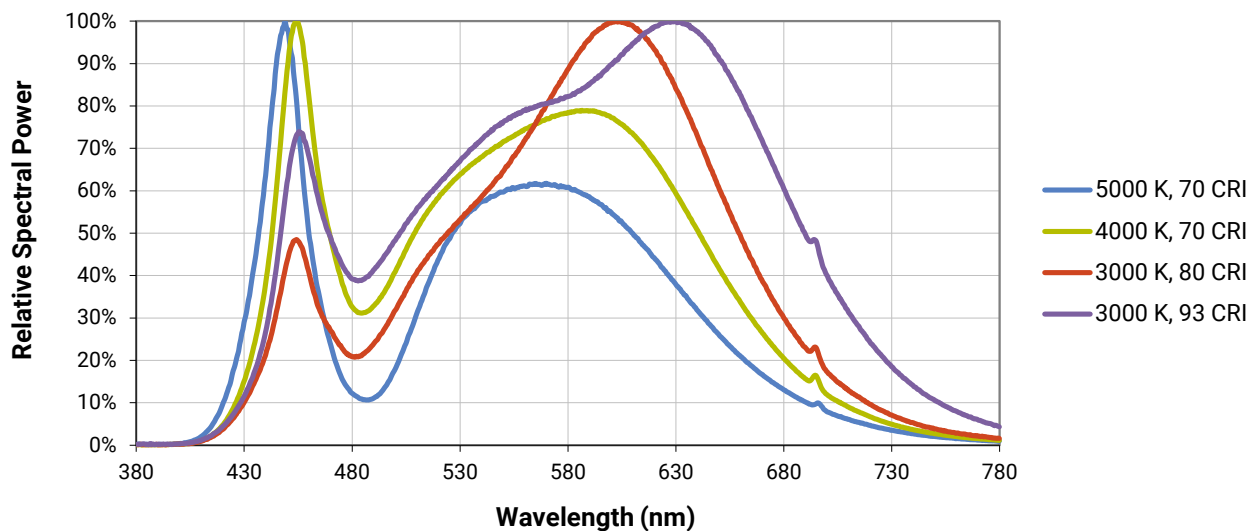
Nominal CCT	CRI		Minimum Luminous Flux			Chromaticity Regions	Order Code
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C*		
6500 K	70	75	P2	1830	2028	1A0, 1B0, 1C0, 1D0, 65F	CXA1816-0000-000N00P20E1
			P4	1965	2177		CXA1816-0000-000N00P40E1
			Q2	2100	2327		CXA1816-0000-000N00Q20E1
	80	---	P2	1830	2028	1A0, 1B0, 1C0, 1D0, 65F	CXA1816-0000-000N0HP20E1
			P4	1965	2177		CXA1816-0000-000N0HP40E1
			Q2	2100	2327		CXA1816-0000-000N0HQ20E1
5700 K	70	75	P4	1965	2177	2A0, 2B0, 2C0, 2D0, 57F	CXA1816-0000-000N00P40E2
			Q2	2100	2327		CXA1816-0000-000N00Q20E2
			Q4	2260	2542		CXA1816-0000-000N00Q40E2
	80	---	P2	1830	2028	2A0, 2B0, 2C0, 2D0, 57F	CXA1816-0000-000N0HP20E2
			P4	1965	2177		CXA1816-0000-000N0HP40E2
			Q2	2100	2327		CXA1816-0000-000N0HQ20E2
5000 K	70	75	P4	1965	2177	3A0, 3B0, 3C0, 3D0, 50F	CXA1816-0000-000N00P40E3
			Q2	2100	2327		CXA1816-0000-000N00Q20E3
			Q4	2260	2542		CXA1816-0000-000N00Q40E3
	80	---	P2	1830	2028	3A0, 3B0, 3C0, 3D0, 50F	CXA1816-0000-000N0HP20E3
			P4	1965	2177		CXA1816-0000-000N0HP40E3
			Q2	2100	2327		CXA1816-0000-000N0HQ20E3
4000 K	70	75	P2	1830	2028	5A0, 5B0, 5C0, 5D0, 40F	CXA1816-0000-000N00P20E5
			P4	1965	2177		CXA1816-0000-000N00P40E5
			Q2	2100	2327		CXA1816-0000-000N00Q20E5

Notes

- Cree maintains a tolerance of $\pm 7\%$ 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 CXA1304 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.

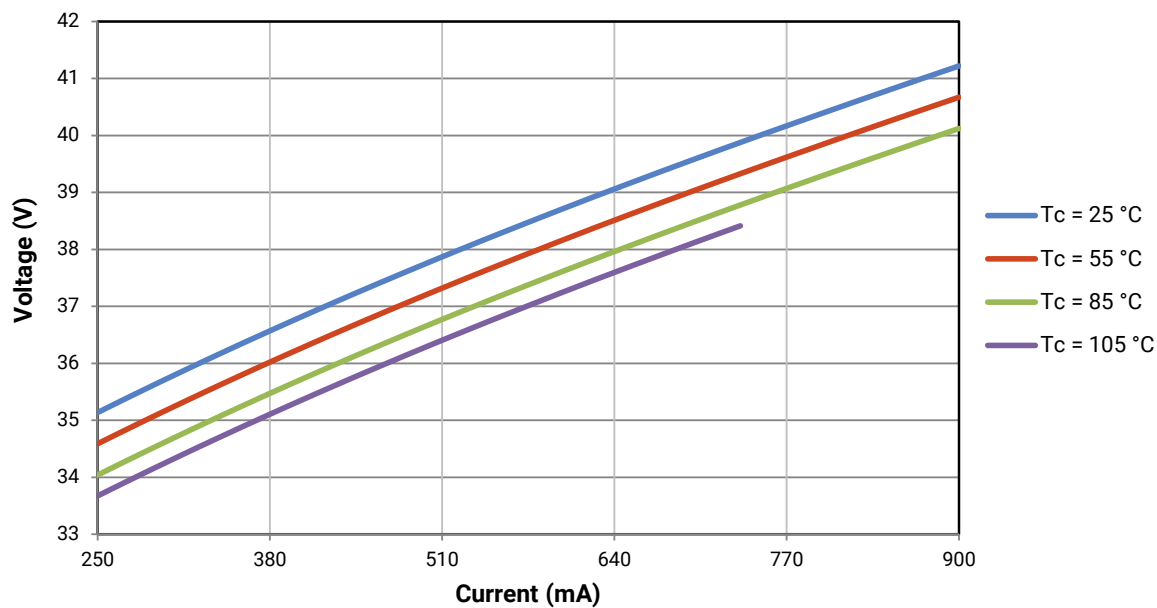
RELATIVE SPECTRAL POWER DISTRIBUTION

The following graph is the result of a series of pulsed measurements at 450 mA and $T_j = 85^\circ\text{C}$.



ELECTRICAL CHARACTERISTICS

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

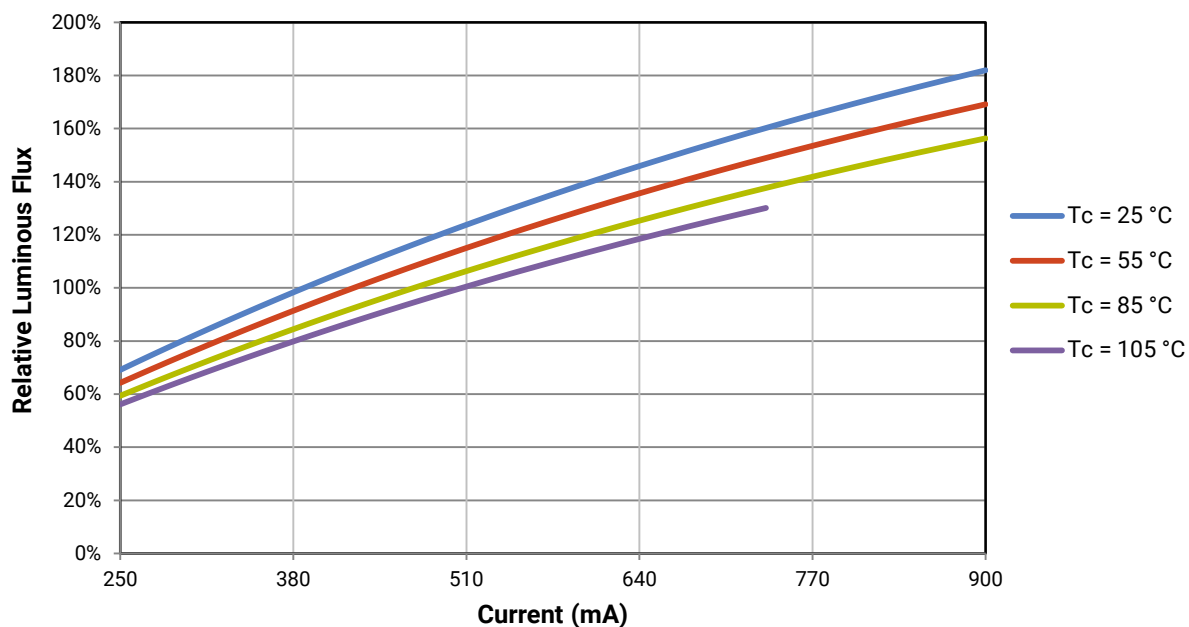


RELATIVE LUMINOUS FLUX

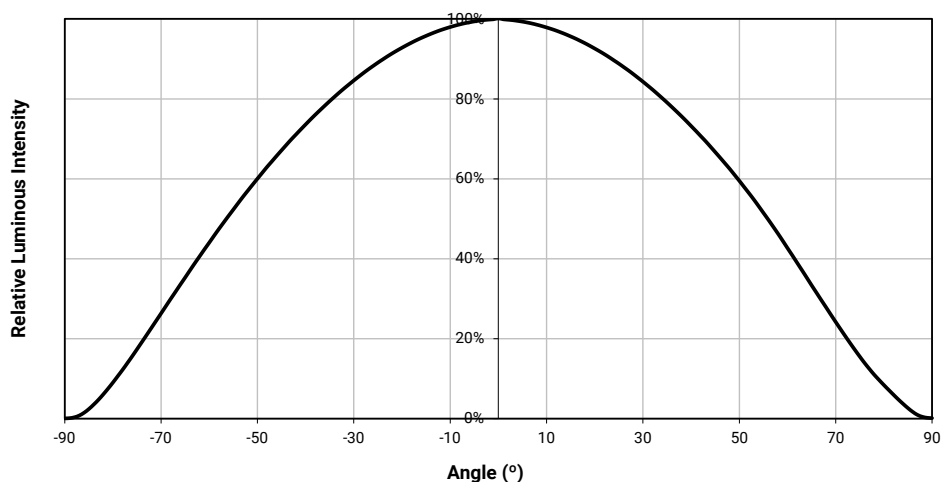
The relative luminous flux values provided below are the ratio of:

- Measurements of CXA1816 at steady-state operation at the given conditions, divided by
- Flux measured during binning, which is a pulsed measurement at 450 mA at $T_j = 85^\circ\text{C}$.

For example, at steady-state operation of $T_c = 105^\circ\text{C}$, $I_F = 380\text{ mA}$, the relative luminous flux ratio is 80% in the chart below. A CXA1816 LED that measures 2100 lm during binning will deliver 1680 lm (2100×0.8) at steady-state operation of $T_c = 105^\circ\text{C}$, $I_F = 380\text{ mA}$.



TYPICAL SPATIAL DISTRIBUTION



PERFORMANCE GROUPS - BRIGHTNESS ($I_F = 450 \text{ mA}$, $T_J = 85^\circ\text{C}$)

XLamp CXA1816 LEDs are tested for luminous flux and placed into one of the following bins.

Group Code	Minimum Luminous Flux	Maximum Luminous Flux
K2	1200	1290
K4	1290	1380
M2	1380	1485
M4	1485	1590
N2	1590	1710
N4	1710	1830
P2	1830	1965
P4	1965	2100
Q2	2100	2260
Q4	2260	2420
R2	2420	2600

PERFORMANCE GROUPS - CHROMATICITY ($T_j = 85\text{ }^{\circ}\text{C}$)

XLamp CXA1816 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

PERFORMANCE GROUPS - CHROMATICITY ($T_j = 85^\circ\text{C}$) - 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

PERFORMANCE GROUPS - CHROMATICITY ($T_j = 85\text{ }^{\circ}\text{C}$) - CONTINUED

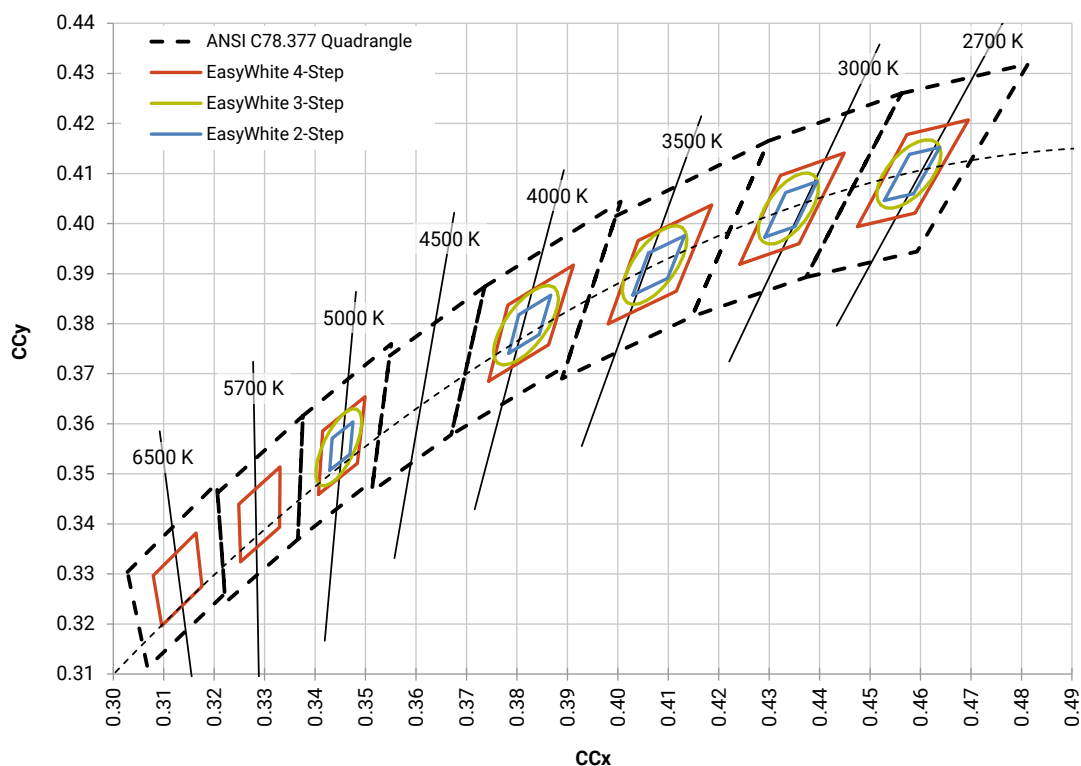
ANSI White Bins				
Code	CCT	Bin Code	x	y
0E1	6500 K	1A0	0.3048	0.3207
			0.3130	0.3290
			0.3144	0.3186
			0.3068	0.3113
		1B0	0.3028	0.3304
			0.3115	0.3391
			0.3130	0.3290
			0.3048	0.3207
		1C0	0.3115	0.3391
			0.3205	0.3481
			0.3213	0.3373
			0.3130	0.3290
		1D0	0.3130	0.3290
			0.3213	0.3373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

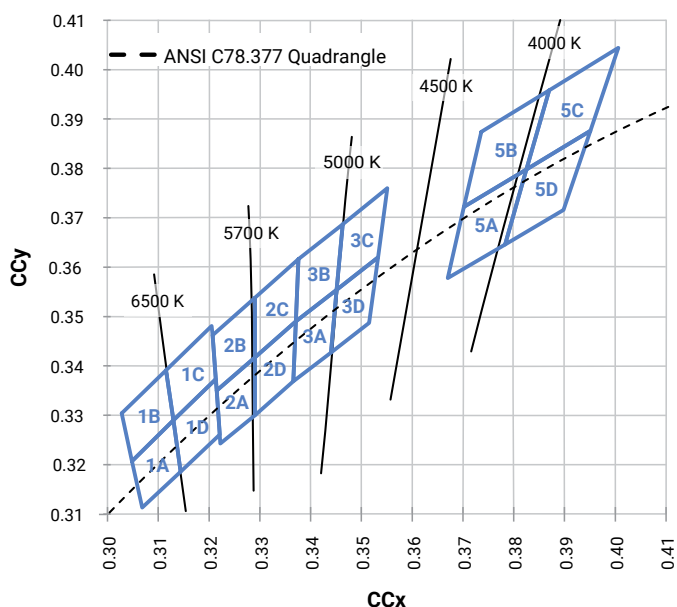
ANSI White Bins				
Code	CCT	Bin Code	x	y
0E3	5000 K	3A0	.3371	.3490
			.3451	.3554
			.3440	.3427
			.3366	.3369
		3B0	.3376	.3616
			.3463	.3687
			.3451	.3554
			.3371	.3490
		3C0	.3463	.3687
			.3551	.3760
			.3533	.3620
			.3451	.3554
		3D0	.3451	.3554
			.3533	.3620
			.3515	.3487
			.3440	.3427

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

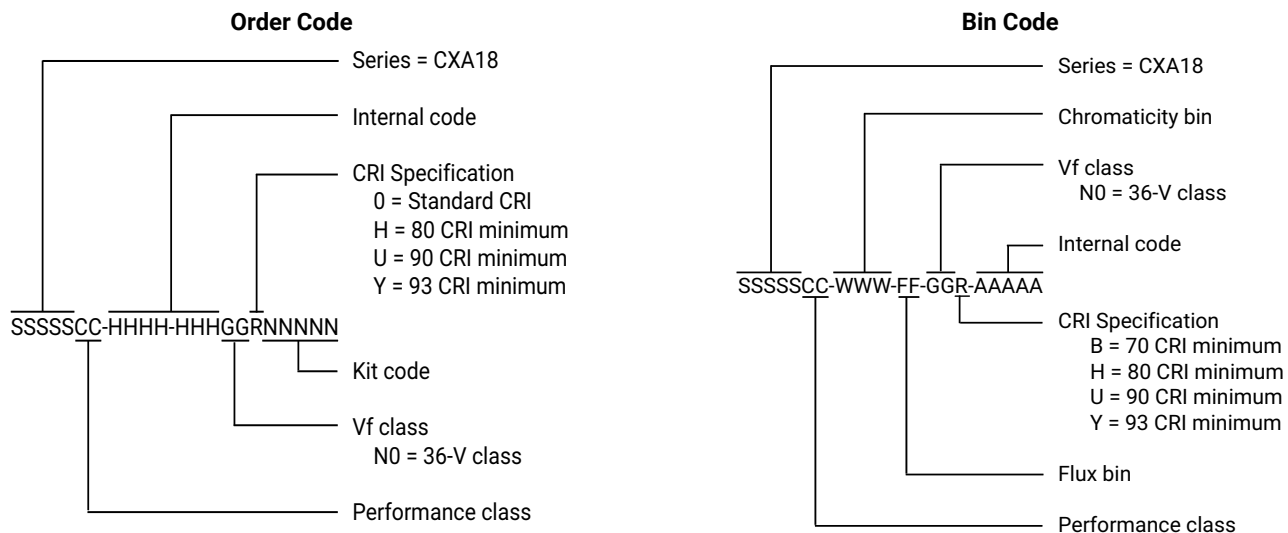
CREE EASYWHITE® BINS PLOTTED ON THE 1931 CIE COLOR SPACE ($T_j = 85^\circ\text{C}$)



CREE ANSI WHITE BINS PLOTTED ON THE 1931 CIE COLOR SPACE ($T_j = 85^\circ\text{C}$)

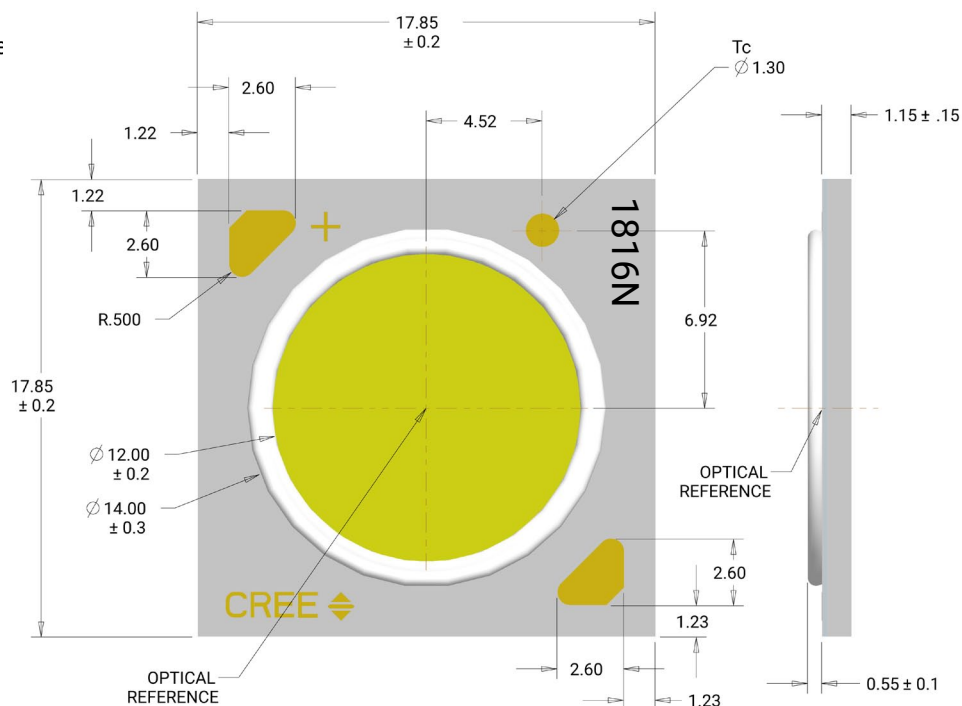


Bin codes and order codes are configured as follows:



Dimensions are in mm.
Tolerances unless otherwise
specified: ± 13
 $x^{\circ} + 1^{\circ}$

1816N = 36-V CXA1816



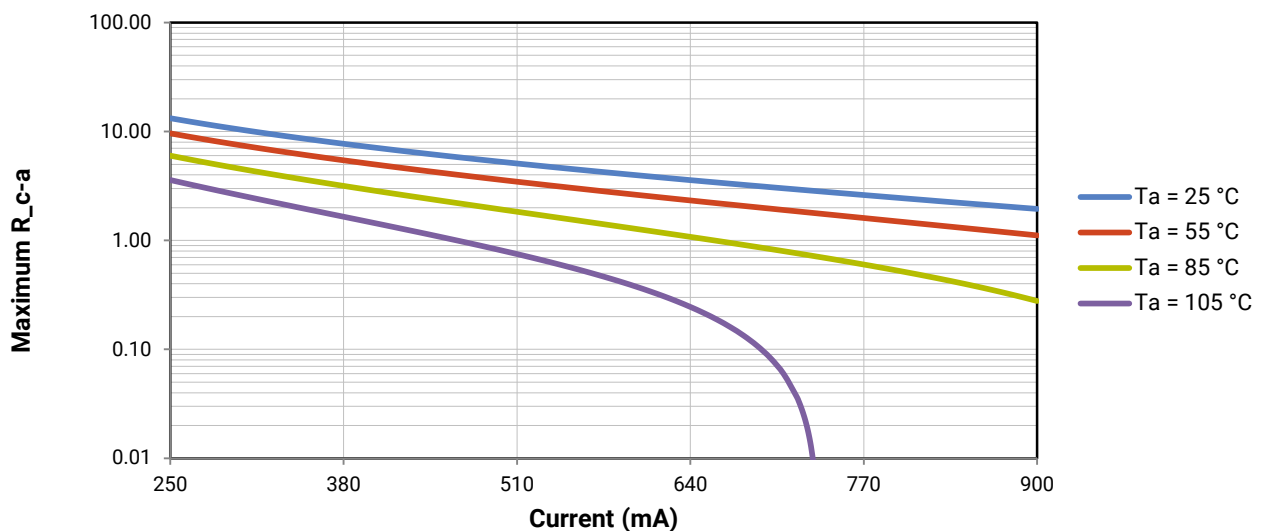
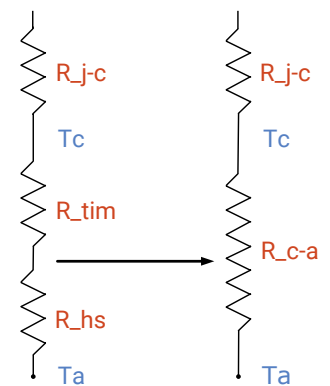
THERMAL DESIGN

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 (T_c). 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](#) provide basic information on the requirements to use Cree XLamp CXA LEDs successfully in luminaire designs.

To keep the CXA1816 LED at or below the maximum rated T_c , 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}).



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](#).

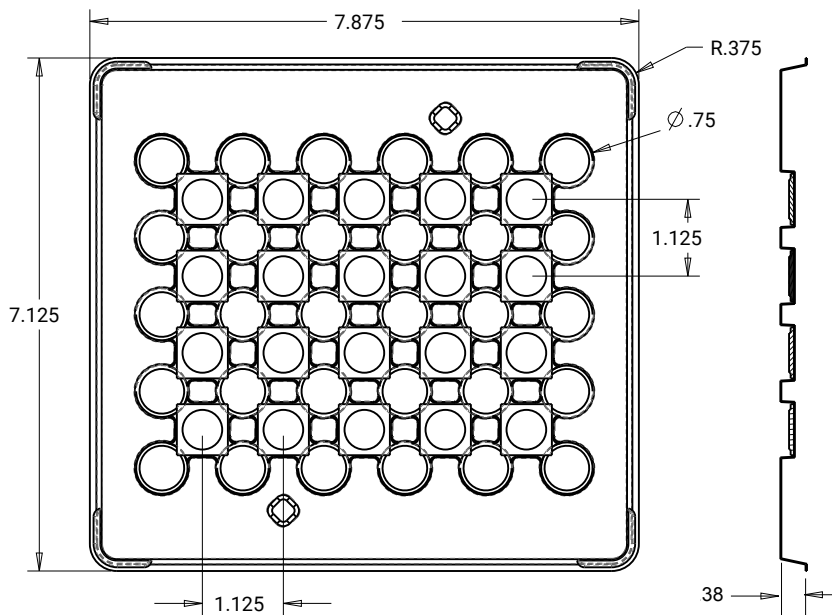
PACKAGING

Cree CXA1816 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.

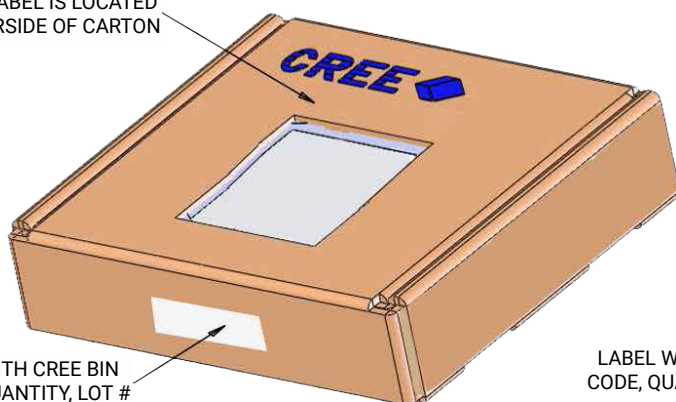
Tolerances: $\pm .13$

$x^{\circ} \pm 1^{\circ}$



PATENT LABEL IS LOCATED ON UNDERSIDE OF CARTON

LABEL WITH CREE BIN CODE, QUANTITY, LOT #



BAG

LABEL WITH CREE BIN CODE, QUANTITY, LOT #

