

Cree® XLamp® CXB1507 LED



PRODUCT DESCRIPTION

The XLamp® CXB1507 LED Array is a member of the second generation of the CXA family that delivers up to 30% higher efficacy and up to 20% higher lumens than the first generation in the same LES. The higher performance second generation CXA LED Arrays are compatible with the first generation, providing a drop-in performance upgrade to existing CXA LED designs to shorten the luminaire design cycle and improve time to market. Available in 2-step, 3-step and 5-step EasyWhite® bins, the CXB1507 LED delivers high lumen output and high efficacy in a single, easy-to-use package that eliminates the need for reflow soldering, enabling lighting manufacturers to rapidly address small form factor lighting applications.

The [CX Family LED Design Guide](#) provides basic information on the requirements to use the CXB1507 LED successfully in luminaire designs.

FEATURES

- 9-mm optical source
- Mechanical and optical design consistent with other CXA15 and CXB15 LEDs
- Available in 70-, 80- and 90-minimum CRI options
- Cree EasyWhite® 2-, 3- and 5-step binning
- Forward voltage options: 18-V class & 36-V class
- 85 °C binning and characterization
- Extremely uniform color over viewing angle
- 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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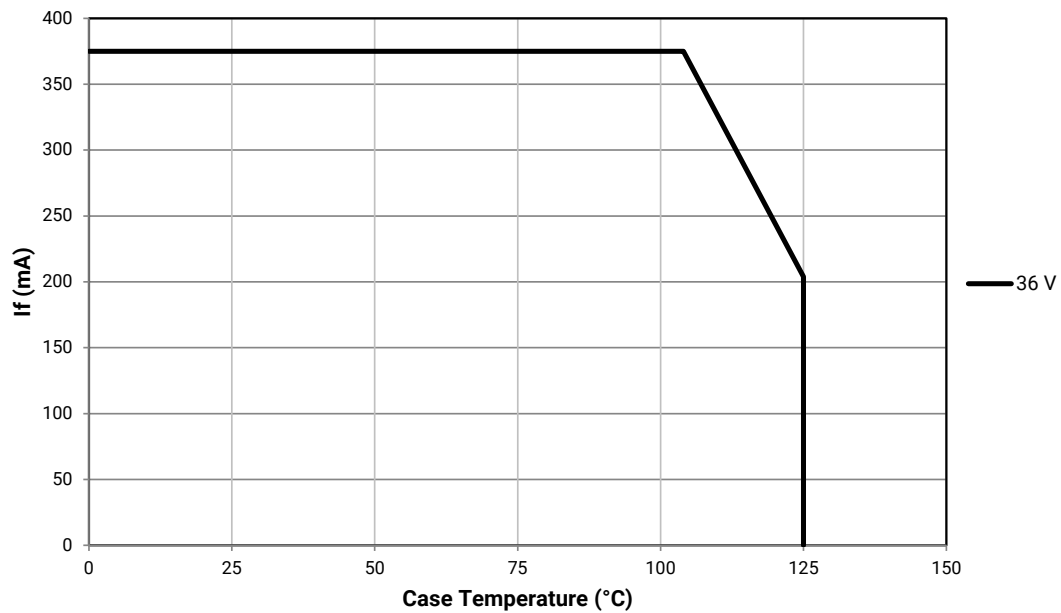
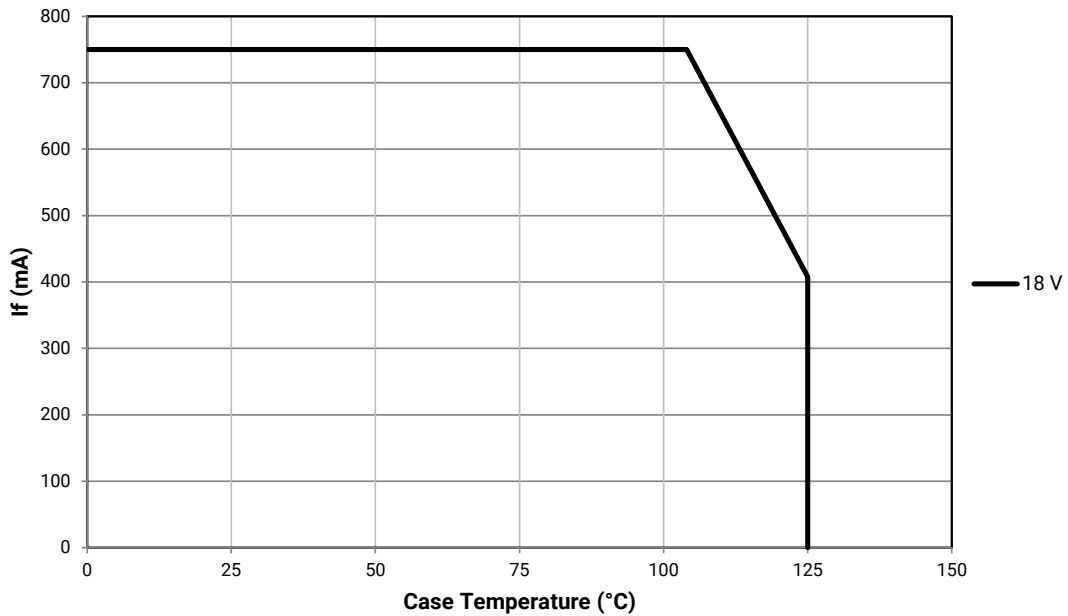
CHARACTERISTICS

Characteristics	Unit	Minimum	Typical	Maximum
Viewing angle (FWHM)	degrees		115	
ESD withstand voltage (HBM per Mil-Std-883D)	V			8000
DC forward current (18 V)	mA			750*
DC forward current (36 V)	mA			375*
Reverse current 18 V, 36 V)	mA			0.1
Forward voltage (18 V, 400 mA, 85 °C)	V		17.3	19
Forward voltage (36 V, 200 mA, 85 °C)	V		34.5	38

* Refer to the Operating Limits section.

OPERATING LIMITS

The maximum current rating of the CXB1507 is dependent on the case temperature (T_c) when the LED has reached thermal equilibrium under steady-state operation. The graphs shown below assume 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 17 for the location of the T_c measurement point.



FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS - 18 V ($I_F = 400 \text{ mA}$, $T_J = 85 \text{ °C}$)

The following table provides order codes for XLamp CXB1507 LEDs. For a complete description of the order code nomenclature, please see the Bin and Order Code Formats section (page 17).

Nominal CCT	CRI*		Minimum Luminous Flux			2-Step		3-Step		5-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C**	Group	Order Code	Group	Order Code	Group	Order Code
6500 K	70	---	H4	970	1080					65E	CXB1507-0000-000F0BH465E
			J2	1040	1158						CXB1507-0000-000F0BJ265E
			J4	1120	1247						CXB1507-0000-000F0BJ465E
	80	---	H4	970	1080					65E	CXB1507-0000-000F0HH465E
			J2	1040	1158						CXB1507-0000-000F0HJ265E
5700 K	70	---	H4	970	1080					57E	CXB1507-0000-000F0BH457E
			J2	1040	1158						CXB1507-0000-000F0BJ257E
			J4	1120	1247						CXB1507-0000-000F0BJ457E
	80	---	H4	970	1080					57E	CXB1507-0000-000F0HH457E
			J2	1040	1158						CXB1507-0000-000F0HJ257E
5000 K	70	---	H4	970	1080					50E	CXB1507-0000-000F0BH450E
			J2	1040	1158						CXB1507-0000-000F0BJ250E
			J4	1120	1247						CXB1507-0000-000F0BJ450E
	80	---	H4	970	1080			50G		50E	CXB1507-0000-000F0HH450G
			J2	1040	1158						CXB1507-0000-000F0HJ250G
	90	92	G4	840	935			50G			CXB1507-0000-000F0UG450G
			H2	900	1002						CXB1507-0000-000F0UH250G
			H4	970	1080						CXB1507-0000-000F0UH450G

- 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 21).
 - Cree XLamp CXB1507 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.
 - * For 80 CRI minimum LEDs, CRI R9 minimum is 0 with a ± 2 tolerance. For 90 CRI minimum LEDs, CRI R9 typical is 60.
 - ** Flux values @ 25 °C are calculated and for reference only.

FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS - 18 V (I_F = 400 mA, T_J = 85 °C) - CONTINUED

Nominal CCT	CRI*		Minimum Luminous Flux			2-Step		3-Step		5-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C**	Group	Order Code	Group	Order Code	Group	Order Code
4000 K	70	---	H4	970	1080					40E	CXB1507-0000-000F0BH440E
			J2	1040	1158		CXB1507-0000-000F0BJ240E				
			J4	1120	1247		CXB1507-0000-000F0BJ440E				
	80	---	H2	900	1002	40H	CXB1507-0000-000F0HH240H	40G	CXB1507-0000-000F0HH240G		
			H4	970	1080		CXB1507-0000-000F0HH440H		CXB1507-0000-000F0HH440G		
			J2	1040	1158		CXB1507-0000-000F0HJ240H		CXB1507-0000-000F0HJ240G		
	90	92	G2	780	869	40H	CXB1507-0000-000F0UG240H	40G	CXB1507-0000-000F0UG240G		
			G4	840	935		CXB1507-0000-000F0UG440H		CXB1507-0000-000F0UG440G		
			H2	9020	1002		CXB1507-0000-000F0UH240H		CXB1507-0000-000F0UH240G		
3500 K	80	---	H2	900	1002	35H	CXB1507-0000-000F0HH235H	35G	CXB1507-0000-000F0HH235G		
			H4	970	1080		CXB1507-0000-000F0HH435H		CXB1507-0000-000F0HH435G		
			J2	1040	1158		CXB1507-0000-000F0HJ235H		CXB1507-0000-000F0HJ235G		
	90	92	G2	780	869	35H	CXB1507-0000-000F0UG235H	35G	CXB1507-0000-000F0UG235G		
			G4	840	935		CXB1507-0000-000F0UG435H		CXB1507-0000-000F0UG435G		
			H2	9020	1002		CXB1507-0000-000F0UH235H		CXB1507-0000-000F0UH235G		
3000 K	80	---	G4	840	935	30H	CXB1507-0000-000F0HG430H	30G	CXB1507-0000-000F0HG430G		
			H2	900	1002		CXB1507-0000-000F0HH230H		CXB1507-0000-000F0HH230G		
			H4	970	1080		CXB1507-0000-000F0HH430H		CXB1507-0000-000F0HH430G		
	90	92	F4	730	813	30H	CXB1507-0000-000F0UF430H	30G	CXB1507-0000-000F0UF430G		
			G2	780	869		CXB1507-0000-000F0UG230H		CXB1507-0000-000F0UG230G		
			G4	840	935		CXB1507-0000-000F0UG430H		CXB1507-0000-000F0UG430G		

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- 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 21).
 - Cree XLamp CXB1507 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 values @ 25 °C are calculated and for reference only.

FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS - 18 V ($I_F = 400 \text{ mA}$, $T_J = 85 \text{ °C}$) - CONTINUED

Nominal CCT	CRI*		Minimum Luminous Flux			2-Step		3-Step		5-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C**	Group	Order Code	Group	Order Code	Group	Order Code
2700 K	80	---	G4	840	935	27H	CXB1507-0000-000F0HG427H	27G	CXB1507-0000-000F0HG427G		
			H2	900	1002		CXB1507-0000-000F0HH227H		CXB1507-0000-000F0HH227G		
			H4	970	1080		CXB1507-0000-000F0HH427H		CXB1507-0000-000F0HH427G		
	90	92	F2	680	757	27H	CXB1507-0000-000F0UF227H	27G	CXB1507-0000-000F0UF227G		
			F4	730	813		CXB1507-0000-000F0UF427H		CXB1507-0000-000F0UF427G		
			G2	780	869		CXB1507-0000-000F0UG227H		CXB1507-0000-000F0UG227G		

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FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS - 36 V ($I_F = 200 \text{ mA}$, $T_J = 85 \text{ °C}$)

The following table provides order codes for XLamp CXB1507 LEDs. For a complete description of the order code nomenclature, please see the Bin and Order Code Formats section (page 17).

Nominal CCT	CRI*		Minimum Luminous Flux			2-Step		3-Step		5-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C**	Group	Order Code	Group	Order Code	Group	Order Code
6500 K	70	---	H4	970	1080					65E	CXB1507-0000-000NOBH465E
			J2	1040	1158						CXB1507-0000-000NOBJ265E
			J4	1120	1247						CXB1507-0000-000NOBJ465E
	80	---	H4	970	1080					65E	CXB1507-0000-000NOHH465E
			J2	1040	1158						CXB1507-0000-000NOHJ265E
5700 K	70	---	H4	970	1080					57E	CXB1507-0000-000NOBH457E
			J2	1040	1158						CXB1507-0000-000NOBJ257E
			J4	1120	1247						CXB1507-0000-000NOBJ457E
	80	---	H4	970	1080					57E	CXB1507-0000-000NOHH457E
			J2	1040	1158						CXB1507-0000-000NOHJ257E
5000 K	70	---	H4	970	1080					50E	CXB1507-0000-000NOBH450E
			J2	1040	1158						CXB1507-0000-000NOBJ250E
			J4	1120	1247						CXB1507-0000-000NOBJ450E
	80	---	H4	970	1080			50G		50E	CXB1507-0000-000NOHH450G
			J2	1040	1158						CXB1507-0000-000NOHJ250G
	90	92	G4	840	935			50G			CXB1507-0000-000NOUG450G
			H2	900	1002						CXB1507-0000-000NOUH250G
			H4	970	1080						CXB1507-0000-000NOUH450G

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FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS - 36 V (I_F = 200 mA, T_J = 85 °C) - CONTINUED

Nominal CCT	CRI*		Minimum Luminous Flux			2-Step		3-Step		5-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C**	Group	Order Code	Group	Order Code	Group	Order Code
4000 K	70	---	H4	970	1080					40E	CXB1507-0000-000NOBH440E
			J2	1040	1158		CXB1507-0000-000NOBJ240E				
			J4	1120	1247		CXB1507-0000-000NOBJ440E				
	80	---	H2	900	1002	40H	CXB1507-0000-000NOHH240H	40G	CXB1507-0000-000NOHH240G		
			H4	970	1080		CXB1507-0000-000NOHH440H		CXB1507-0000-000NOHH440G		
			J2	1040	1158		CXB1507-0000-000NOHJ240H		CXB1507-0000-000NOHJ240G		
	90	92	G2	780	869	40H	CXB1507-0000-000NOUG240H	40G	CXB1507-0000-000NOUG240G		
			G4	840	935		CXB1507-0000-000NOUG440H		CXB1507-0000-000NOUG440G		
			H2	9020	1002		CXB1507-0000-000NOUH240H		CXB1507-0000-000NOUH240G		
3500 K	80	---	H2	900	1002	35H	CXB1507-0000-000NOHH235H	35G	CXB1507-0000-000NOHH235G		
			H4	970	1080		CXB1507-0000-000NOHH435H		CXB1507-0000-000NOHH435G		
			J2	1040	1158		CXB1507-0000-000NOHJ235H		CXB1507-0000-000NOHJ235G		
	90	92	G2	780	869	35H	CXB1507-0000-000NOUG235H	35G	CXB1507-0000-000NOUG235G		
			G4	840	935		CXB1507-0000-000NOUG435H		CXB1507-0000-000NOUG435G		
			H2	9020	1002		CXB1507-0000-000NOUH235H		CXB1507-0000-000NOUH235G		
3000 K	80	---	G4	840	935	30H	CXB1507-0000-000NOHG430H	30G	CXB1507-0000-000NOHG430G		
			H2	900	1002		CXB1507-0000-000NOHH230H		CXB1507-0000-000NOHH230G		
			H4	970	1080		CXB1507-0000-000NOHH430H		CXB1507-0000-000NOHH430G		
	90	92	F4	730	813	30H	CXB1507-0000-000NOUF430H	30G	CXB1507-0000-000NOUF430G		
			G2	780	869		CXB1507-0000-000NOUG230H		CXB1507-0000-000NOUG230G		
			G4	840	935		CXB1507-0000-000NOUG430H		CXB1507-0000-000NOUG430G		

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

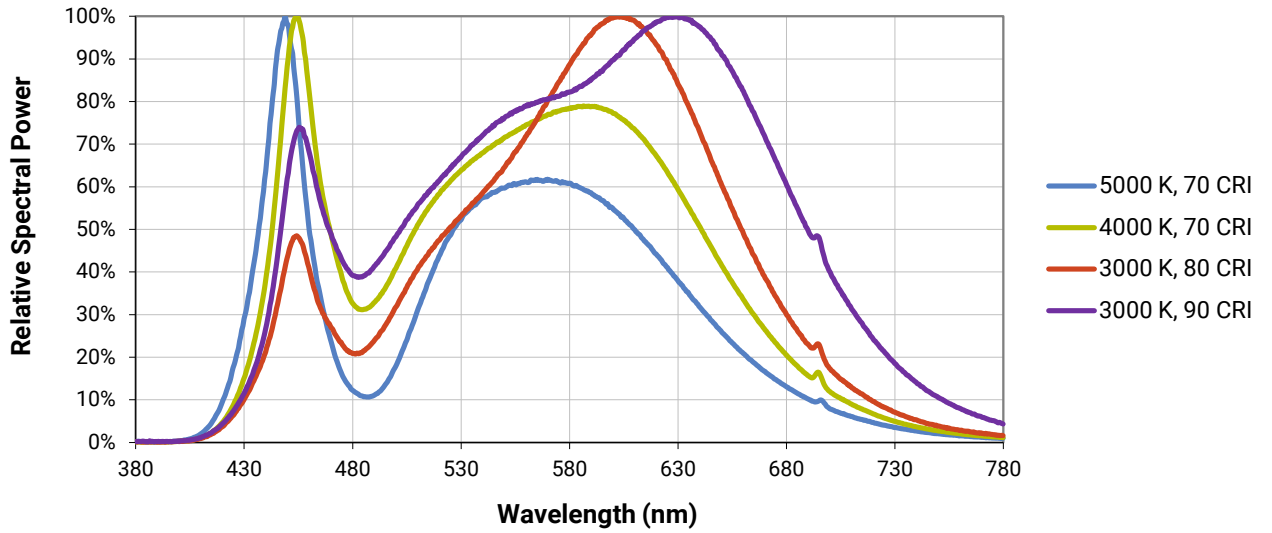
FLUX CHARACTERISTICS, EASYWHITE® ORDER CODES AND BINS - 36 V ($I_F = 200 \text{ mA}$, $T_J = 85 \text{ °C}$) - CONTINUED

Nominal CCT	CRI*		Minimum Luminous Flux			2-Step		3-Step		5-Step	
	Min	Typ	Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C**	Group	Order Code	Group	Order Code	Group	Order Code
2700 K	80	---	G4	840	935	27H	CXB1507-0000-000N0HG427H	27G	CXB1507-0000-000N0HG427G		
			H2	900	1002		CXB1507-0000-000N0HH227H		CXB1507-0000-000N0HH227G		
			H4	970	1080		CXB1507-0000-000N0HH427H		CXB1507-0000-000N0HH427G		
	90	92	F2	680	757	27H	CXB1507-0000-000N0UF227H	27G	CXB1507-0000-000N0UF227G		
			F4	730	813		CXB1507-0000-000N0UF427H		CXB1507-0000-000N0UF427G		
			G2	780	869		CXB1507-0000-000N0UG227H		CXB1507-0000-000N0UG227G		

- 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 21).
 - Cree XLamp CXB1507 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.
 - * For 80 CRI minimum LEDs, CRI R9 minimum is 0 with a ±2 tolerance. For 90 CRI minimum LEDs, CRI R9 typical is 60.
 - ** Flux values @ 25 °C are calculated and for reference only.

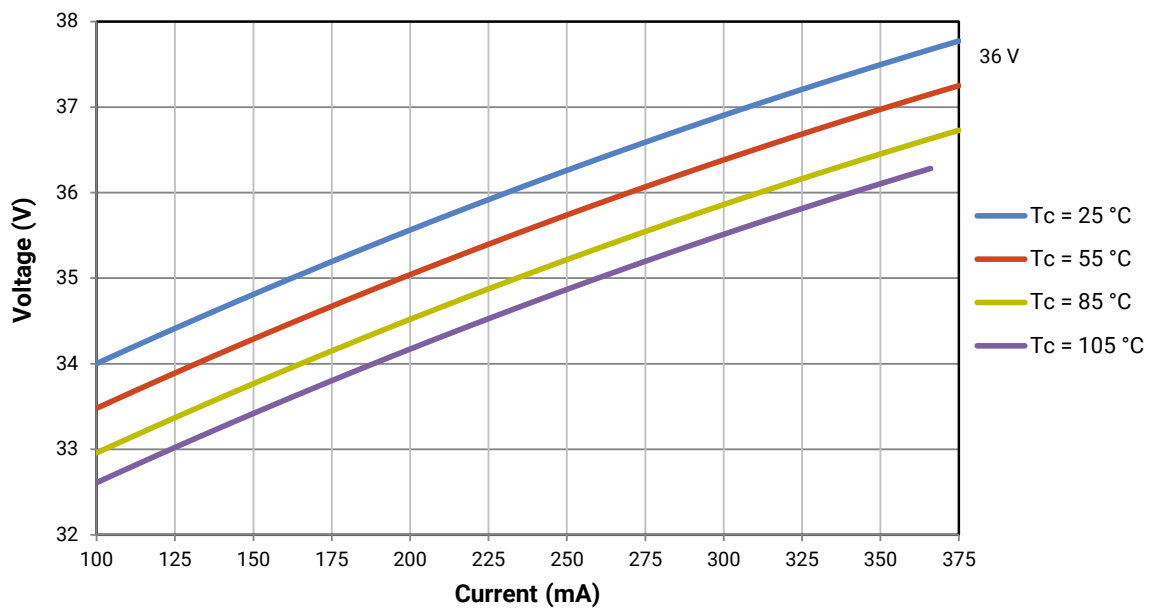
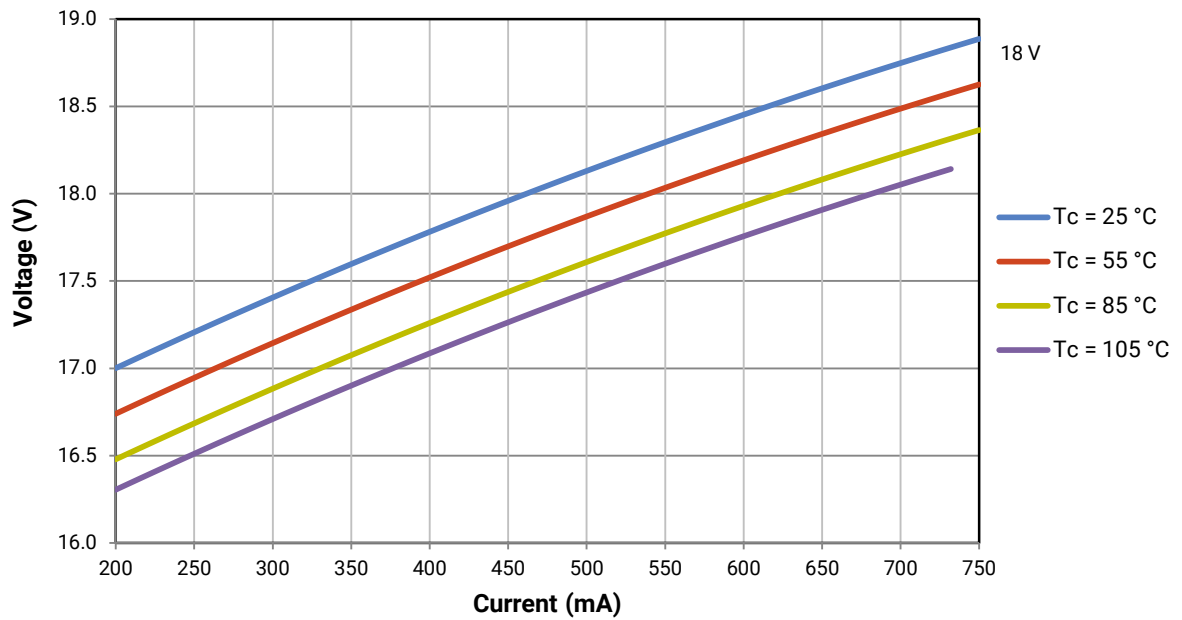
RELATIVE SPECTRAL POWER DISTRIBUTION

The following graph is the result of a series of pulsed measurements at 400 mA for the 18-V CXB1507 LED and 200 mA for the 36-V CXB1507 LED and $T_j = 85\text{ }^\circ\text{C}$.



ELECTRICAL CHARACTERISTICS

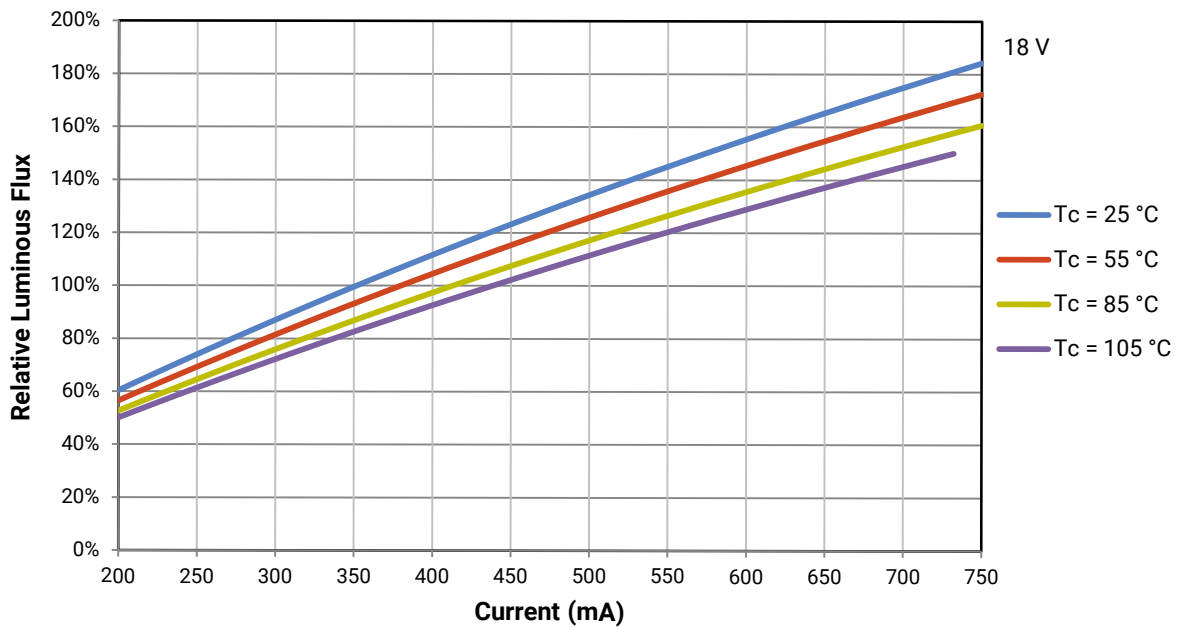
The following graphs are the result of a series of steady-state measurements.



RELATIVE LUMINOUS FLUX

The relative luminous flux values provided below are the ratio of measurements of the CXB1507 LED at steady-state operation at the given conditions, divided by flux measured during binning, which is a pulsed measurement at 400 mA at $T_j = 85\text{ }^\circ\text{C}$ for the 18-V CXB1507 LED.

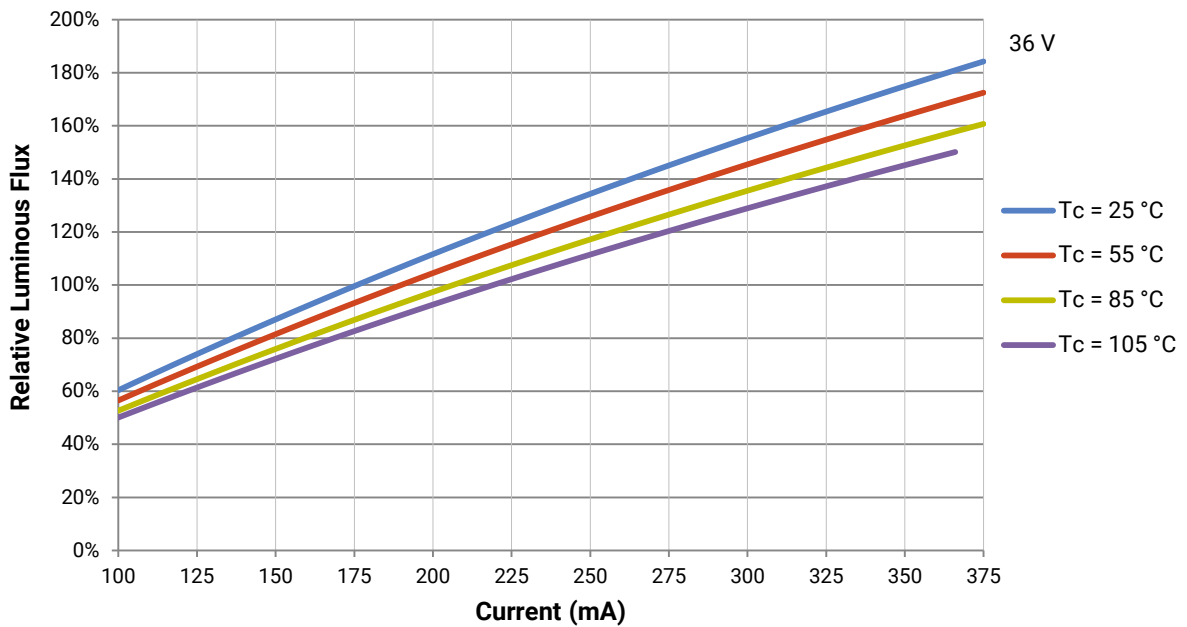
Using the 18-V CXB1507 LED as an example, at steady-state operation of $T_c = 105\text{ }^\circ\text{C}$, $I_f = 550\text{ mA}$, the relative luminous flux ratio is 120% in the chart below. A CXB1507 LED that measures 900 lm during binning will deliver 1080 lm (900×1.2) at steady-state operation of $T_c = 105\text{ }^\circ\text{C}$, $I_f = 550\text{ mA}$.



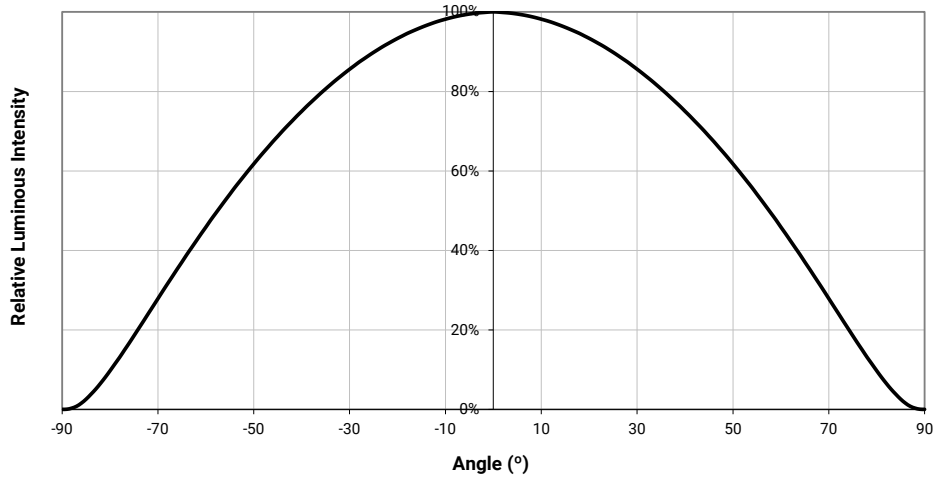
RELATIVE LUMINOUS FLUX - CONTINUED

The relative luminous flux values provided below are the ratio of measurements of the CXB1507 LED at steady-state operation at the given conditions, divided by flux measured during binning, which is a pulsed measurement at 200 mA at $T_j = 85\text{ }^\circ\text{C}$ for the 36-V CXB1507 LED.

Using the 36-V CXB1507 LED as an example, at steady-state operation of $T_c = 105\text{ }^\circ\text{C}$, $I_f = 275\text{ mA}$, the relative luminous flux ratio is 120% in the chart below. A CXB1507 LED that measures 900 lm during binning will deliver 1080 lm ($900 * 1.2$) at steady-state operation of $T_c = 105\text{ }^\circ\text{C}$, $I_f = 275\text{ mA}$.



TYPICAL SPATIAL DISTRIBUTION



PERFORMANCE GROUPS - BRIGHTNESS (18 V, I_F = 400 mA; 36 V, I_F = 200 mA, T_J = 85 °C)

XLamp CXB1507 LEDs are tested for luminous flux and placed into one of the following bins.

Group Code	Minimum Luminous Flux	Maximum Luminous Flux
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 ($T_j = 85\text{ °C}$)

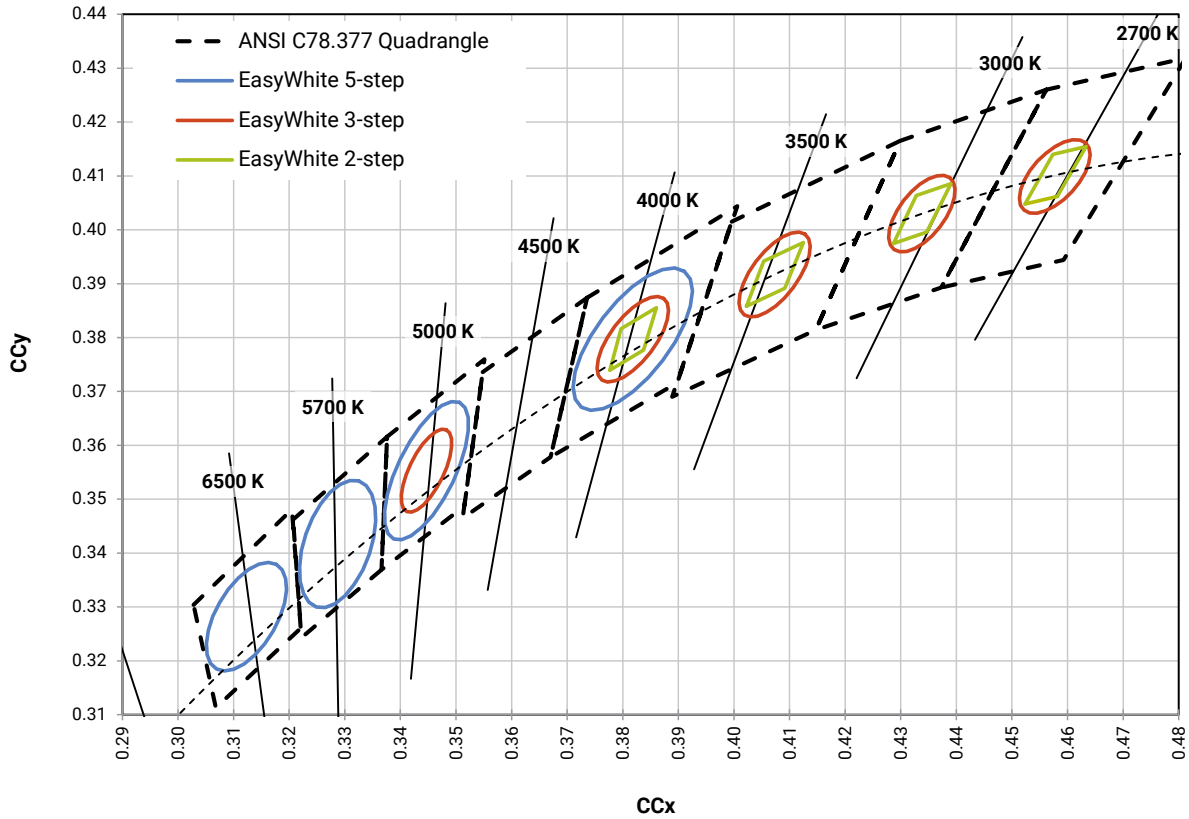
XLamp CXB1507 LEDs are tested for chromaticity and placed into one of the regions defined by the following bounding coordinates.

EasyWhite Color Temperatures – 2-Step			
Code	CCT	x	y
40H	4000 K	0.3777	0.3739
		0.3797	0.3816
		0.3861	0.3855
		0.3838	0.3777
35H	3500 K	0.4022	0.3858
		0.4053	0.3942
		0.4125	0.3977
		0.4091	0.3891
30H	3000 K	0.4287	0.3975
		0.4328	0.4064
		0.4390	0.4086
		0.4347	0.3996
27H	2700 K	0.4524	0.4048
		0.4574	0.4140
		0.4633	0.4154
		0.4581	0.4062

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

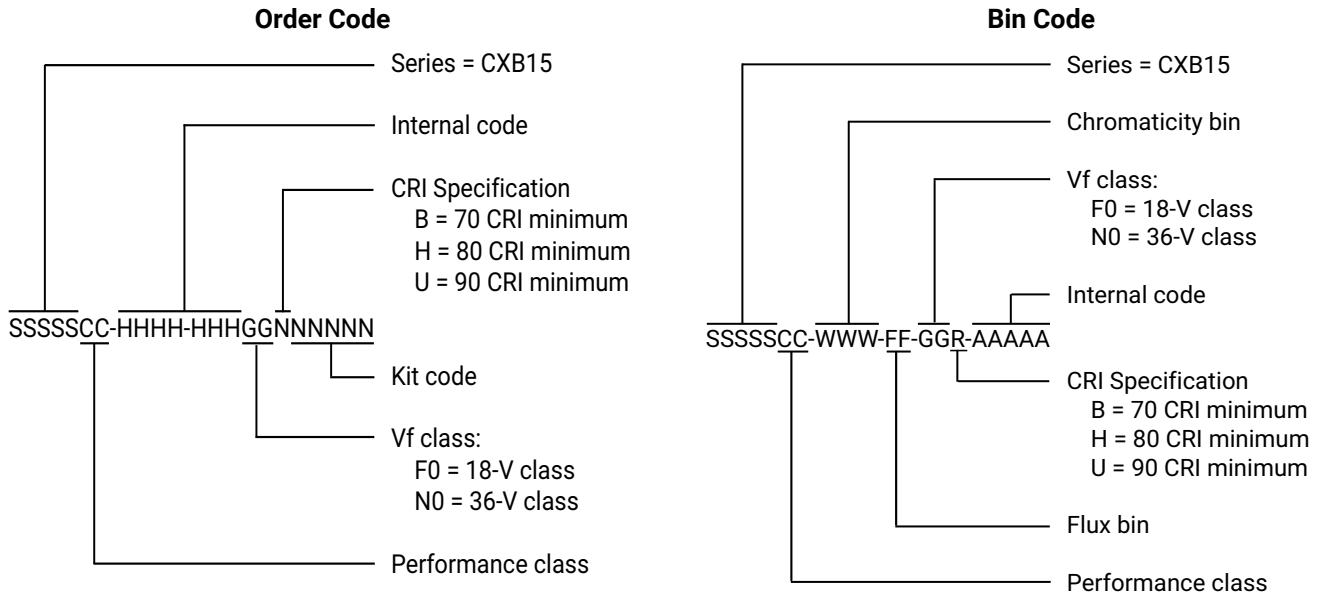
EasyWhite Color Temperatures – 5-Step Ellipse						
Bin Code	CCT	Center Point		Major Axis	Minor Axis	Rotation Angle (°)
		x	y	a	b	
65E	6500 K	0.3123	0.3282	0.01110	0.00550	61.0
57E	5700 K	0.3287	0.3417	0.01230	0.00600	72.0
50E	5000 K	0.3447	0.3553	0.01400	0.00520	65.0
40E	4000 K	0.3818	0.3797	0.01565	0.00670	53.7

CREE EASYWHITE® BINS PLOTTED ON THE 1931 CIE CURVE



BIN AND ORDER CODE FORMATS

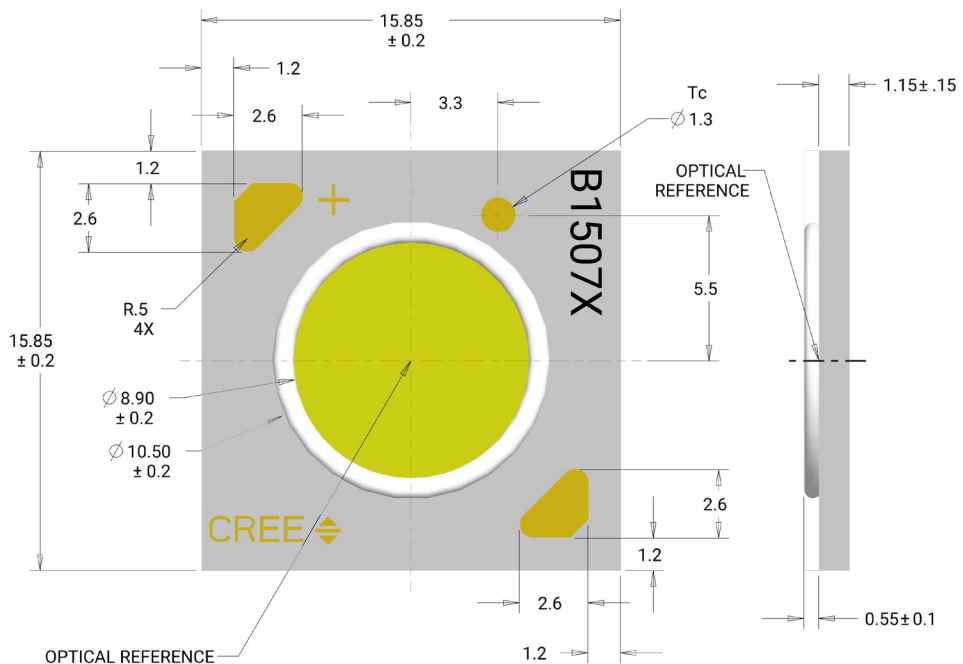
Bin codes and order codes are configured as follows:



MECHANICAL DIMENSIONS

Dimensions are in mm.
 Tolerances unless otherwise specified: $\pm .13$
 $\alpha^\circ \pm 1^\circ$

Meaning of B1507X
 B1507F = 18-V CXB1507
 B1507N = 36-V CXB1507



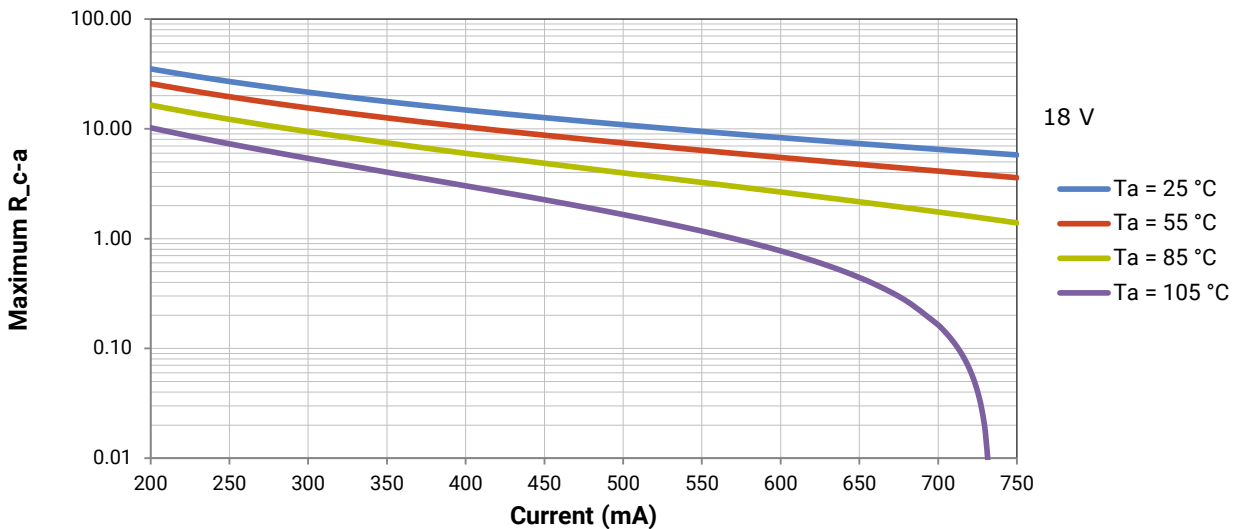
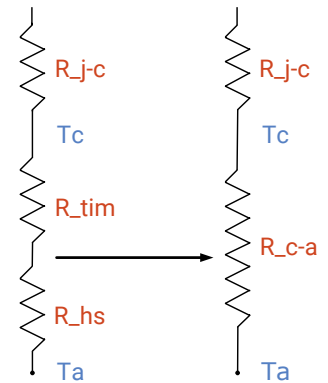
THERMAL DESIGN

The CXB 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 the CXB LED is being operated within its designed limits. Please refer to page 3 for the Operating Limit specification.

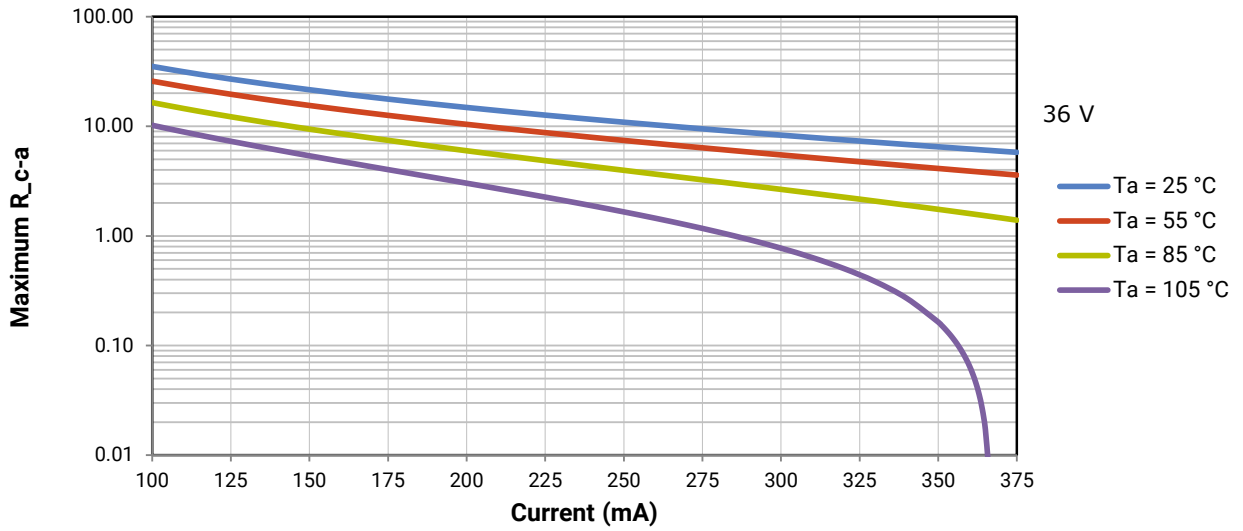
There is no need to calculate for T_j inside the package, as the thermal management design process, specifically from T_{sp} to ambient (T_a), remains identical to any other LED component. For more information on thermal management of Cree XLamp LEDs, please refer to the [Thermal Management application note](#). For CXB soldering recommendations and more information on thermal interface materials (TIM) 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 CXB LEDs successfully in luminaire designs.

To keep the CXB1507 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 graphs, depending on the operating environment. The y-axis in the graphs 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}).



THERMAL DESIGN - CONTINUED



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 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 Declaration. REACH banned substance information (REACH Article 67) is also available upon request.

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.

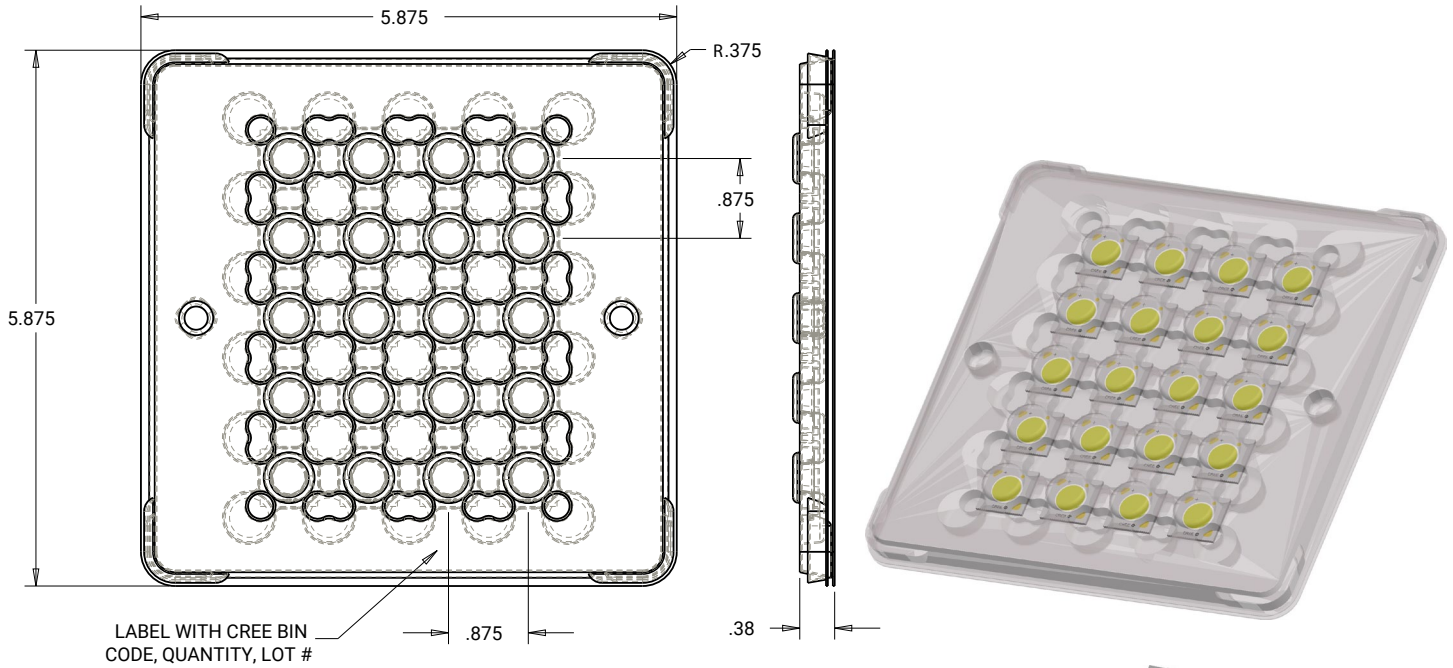
Vision Advisory

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 CXB1507 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
 $x^\circ \pm 1^\circ$



PATENT LABEL IS LOCATED ON UNDERSIDE OF CARTON

