

# LUXEON Rebel

Reliable high-power LED that gives you the design flexibility and performance you need

LUXEON Rebel LEDs deliver optimized combinations of light quality and light output needed for a variety of lighting applications. In addition to delivering specified correlated color temperature and color rendering combinations, these emitters deliver the efficacy, lifetime and reliability that all LUXEON LEDs are renowned for.



## FEATURES AND BENEFITS

Specified CCT & CRI combinations

1/4<sup>th</sup> ANSI binning

High efficacy for sustainable design

More light delivered at operating temperature

Exceeds ENERGY STAR® lumen maintenance requirements

UL-recognized component [E352519]

## PRIMARY APPLICATIONS

Downlights

Lamps

Specialty Lighting

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# General Information

## Part Number Nomenclature

LUXEON Rebel Illumination emitters are tested and binned at 350mA, with current pulse duration of 20 ms. All characteristic charts where the thermal pad is kept at constant temperature (25°C typically) are measured with current pulse duration of 20 ms. Under these conditions, junction temperature and thermal pad temperature are the same.

The LUXEON Rebel Illumination Portfolio is a series of power LED emitters designed for illumination.

The part number designations are explained as follows:

L X M 3 - A B C D

Where:

- A — designates radiation pattern (value P for Lambertian)
- B — designates color (W for White)
- C — designates nominal CCT
- D — designates test current (value 1 for 350mA)

## Average Lumen Maintenance Characteristics

Lumen maintenance for solid-state lighting devices (LEDs) is typically defined in terms of the percentage of initial light output remaining after a specified period of time. Lumileds projects that LUXEON Rebel products will deliver, on average, 70% lumen maintenance (L70) at 50,000 hours of operation at a forward current of up to 700mA. This projection is based on constant current operation with junction temperature maintained at or below 135°C. This performance is based on independent test data, Lumileds historical data from tests run on similar material systems, and internal LUXEON reliability testing. Observation of design limits included in this data sheet is required in order to achieve this projected lumen maintenance.

## Environmental Compliance

Lumileds is committed to providing environmentally friendly products to the solid-state lighting market. LUXEON Rebel is compliant to the European Union directives on the restriction of hazardous substances in electronic equipment, namely REACH and the RoHS directive. Lumileds will not intentionally add the following restricted materials to the LUXEON Rebel: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

# Product Selection for LUXEON Rebel

## Thermal Pad Temperature = 25°C

Table 1.

Nominal CCT	Part Number	Minimum CRI	Typical CRI	Typical R9	Min Luminous Flux $\Phi_v$	Typ Luminous Flux $\Phi_v$
2700K	LXM3-PW81	80	85	18	65	88
3000K	LXM3-PW71	80	85	22	66	94
3500K	LXM3-PW61	80	85	30	67	95
4000K	LXM3-PW51	80	85	28	75	103

Notes for Table 1:

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux measurements and  $\pm 2$  on CRI measurements.
2. Test current is 350mA.

## Optical Characteristics

### LUXEON Rebel at Test Current <sup>[1, 5]</sup>, Thermal Pad Temperature = 25°C

Table 2.

Nominal CCT	Color Temperature <sup>[2]</sup> CCT			Typical Total Included Angle <sup>[3]</sup> (°C) $\theta_{0.90V}$	Typical Viewing Angle <sup>[4]</sup> (°C) $2\theta_{1/2}$
	Minimum	Typical	Maximum		
2700K	2580K	2725K	2870K	160°	120°
3000K	2870K	3045K	3220K	160°	120°
3500K	3220K	3465K	3710K	160°	120°
4000K	3710K	3985K	4260K	160°	120°

Notes for Table 2:

1. Test current is 350mA.
2. CCT  $\pm 5\%$  tester tolerance.
3. Total angle at which 90% of total luminous flux is captured.
4. Viewing angle is the off axis angle from lamp centerline where the luminous intensity is 1/2 of the peak value.
5. All white products are built with Indium Gallium Nitride (InGaN).

# Electrical Characteristics

## Electrical Characteristics at 350mA, Thermal Pad Temperature = 25°C

Table 3.

Part Number	Forward Voltage $V_f$ <sup>[1]</sup> (V)			Typ. Temperature Coefficient of Forward Voltage <sup>[2]</sup> (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Thermal Pad (°C/W) $R\theta_{J-C}$
	Minimum	Typical	Maximum		
LXM3-PW81	2.55	3.00	3.51	-2.0 to -4.0	10
LXM3-PW71	2.55	3.00	3.51	-2.0 to -4.0	10
LXM3-PW61	2.55	3.00	3.51	-2.0 to -4.0	10
LXM3-PW51	2.55	3.00	3.51	-2.0 to -4.0	10

Notes for Table 3:

- Lumileds maintains a tolerance of  $\pm 0.06V$  on forward voltage measurements.
- Measured between 25°C =  $T_j$  = 110°C at  $I_f$  = 350mA.

## Absolute Maximum Ratings

Table 4.

Parameter	Maximum Performance
DC Forward Current (mA) <sup>[3]</sup>	700
Peak Pulsed Forward Current (mA) <sup>[3]</sup>	700
Average Forward Current (mA) <sup>[3]</sup>	700
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A JESD22-A114-E
LED Junction Temperature <sup>[1, 3]</sup>	135°C
Operating Case Temperature at 350mA	-40°C - 135°C
Storage Temperature	-40°C - 135°C
Soldering Temperature	JEDEC 020c 260°C
Allowable Reflow Cycles	3
Autoclave Conditions	121°C at 2 ATM 100% Relative Humidity for 96 Hours Maximum
Reverse Voltage (Vr)	See Note 2

Notes for Table 4:

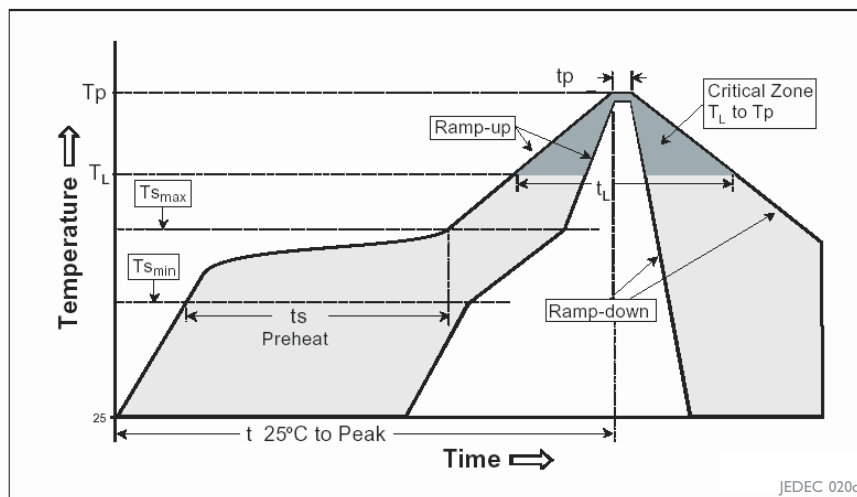
- Proper current derating must be observed to maintain junction temperature below the maximum.
- LUXEON Rebel LEDs are not designed to be driven in reverse bias.
- Maximum Ratings of 1000mA forward drive current or LED junction temperature of 150°C can be applied for device operation not to exceed 60 seconds.

## JEDEC Moisture Sensitivity

Table 5.

Level	Floor Life		Soak Requirements Standard	
	Time	Conditions	Time	Conditions
1	unlimited	$\leq 30^\circ C /$ 85% RH	168h + 5 / - 0	85°C / 85% RH

# Reflow Soldering Characteristics



Temperature profile for Table 7.

Table 6.

Profile Feature	Lead Free Assembly
Average Ramp-Up Rate ( $T_{s_{max}}$ to $T_p$ )	3°C / second max
Preheat Temperature Min ( $T_{s_{min}}$ )	150°C
Preheat Temperature Max ( $T_{s_{max}}$ )	200°C
Preheat Time ( $t_{s_{min}}$ to $t_{s_{max}}$ )	60 - 180 seconds
Temperature ( $T_L$ )	217°C
Time Maintained Above Temperature ( $T_L$ ) ( $t_L$ )	60 - 150 seconds
Peak / Classification Temperature ( $T_p$ )	260°C
Time Within 5°C of Actual Peak Temperature ( $t_p$ )	20 - 40 seconds
Ramp - Down Rate	6°C / second max
Time 25°C to Peak Temperature	8 minutes max

Notes for Table 6:

1. All temperatures refer to the application Printed Circuit Board (PCB), measured on the surface adjacent to the package body.

# Mechanical Dimensions

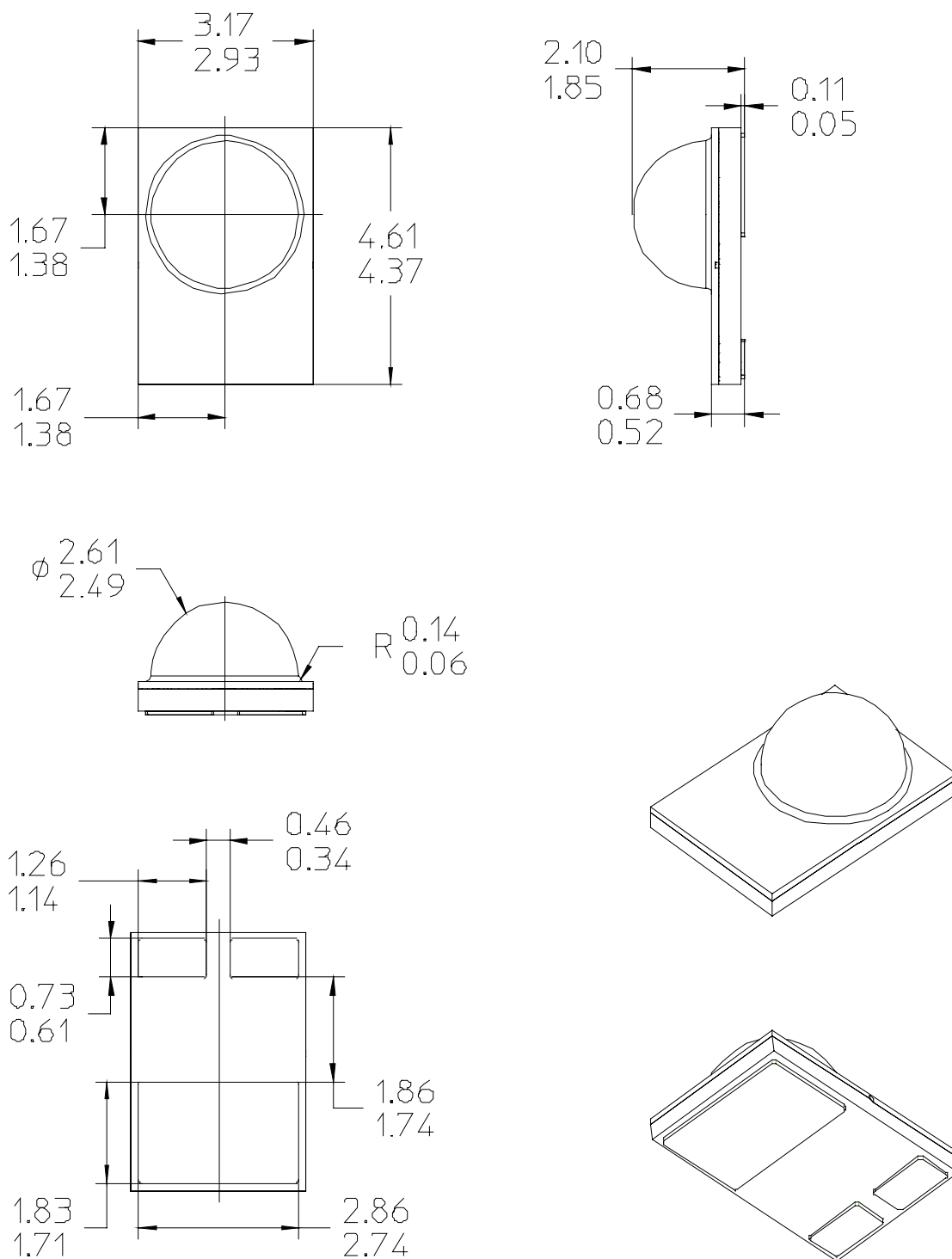
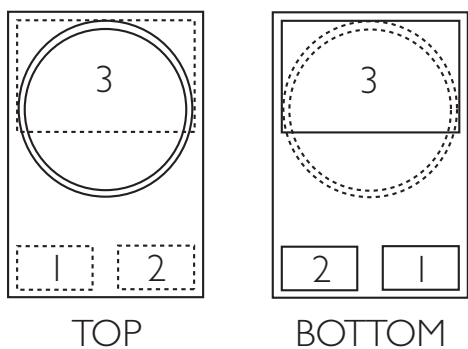


Figure 1. Package outline drawing.

**Notes for Figure 1:**

1. Do not handle the device by the lens—care must be taken to avoid damage to the lens or the interior of the device that can be damaged by excessive force to the lens.
2. Drawings not to scale.
3. All dimensions are in millimeters.
4. The thermal pad is electrically isolated from the anode and cathode contact pads.

## Pad Configuration



PAD	FUNCTION
1	CATHODE
2	ANODE
3	THERMAL

Figure 2. Pad configuration.

Note for Figure 2:

1. The thermal pad is electrically isolated from the anode and cathode contact pads.

## Solder Pad Design

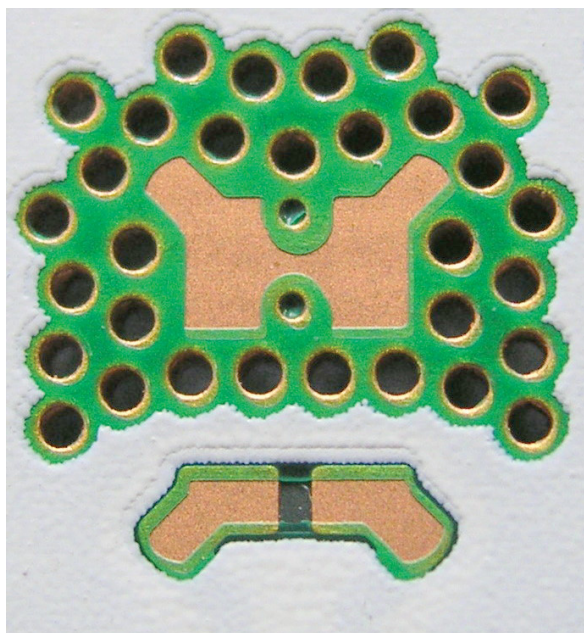


Figure 3. Solder pad layout.

Notes for Figure 3:

1. The photograph shows the recommended LUXEON Rebel layout on Printed Circuit Board (PCB). This design easily achieves a thermal resistance of 7 K/W.
2. Application Brief AB32 provides extensive details for this layout. In addition, the .dwg files are available at [www.lumileds.com](http://www.lumileds.com).



# Relative Spectral Distribution vs. Wavelength Characteristics

LXM3-PW81 (2700K) at Test Current, Thermal Pad Temperature = 25°C

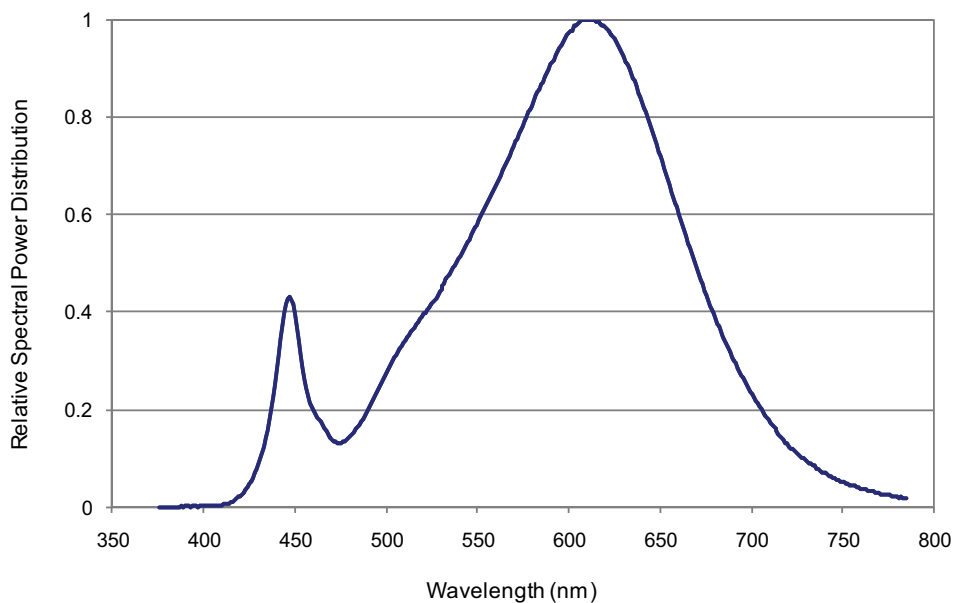


Figure 4. Color spectrum of LXM3-PW81 emitter, integrated measurement.

LXM3-PW71 (3000K) at Test Current, Thermal Pad Temperature = 25°C

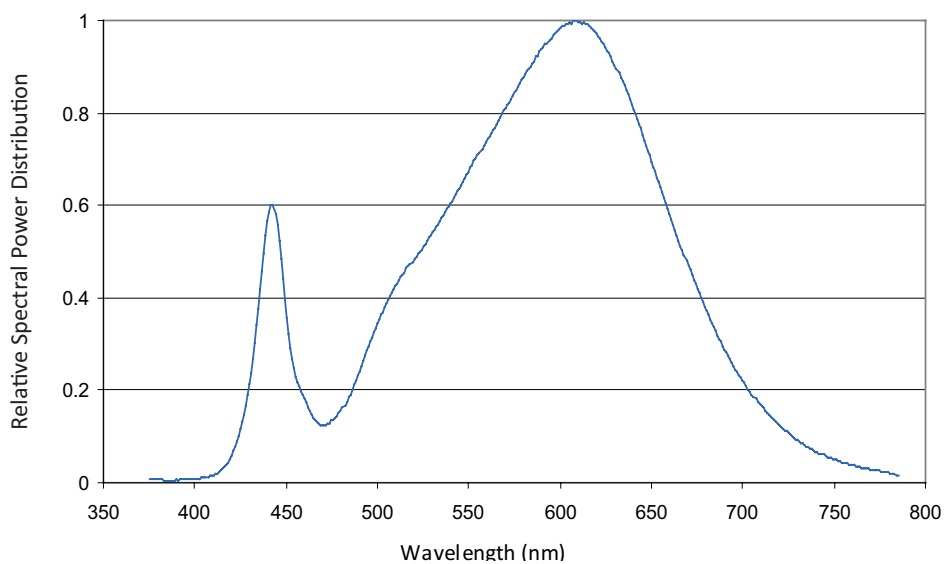


Figure 5. Color spectrum of LXM3-PW71 emitter, integrated measurement.

## LXM3-PW61 (3500K) at Test Current, Thermal Pad Temperature = 25°C

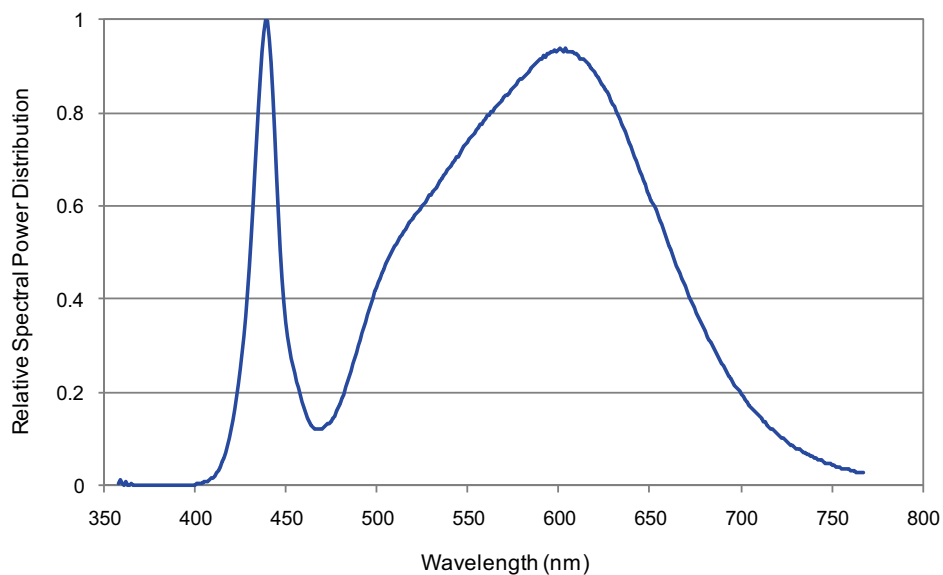


Figure 6. Color spectrum of LXM3-PW61 emitter, integrated measurement.

## LXM3-PW51 (4000K) at Test Current, Thermal Pad Temperature = 25°C

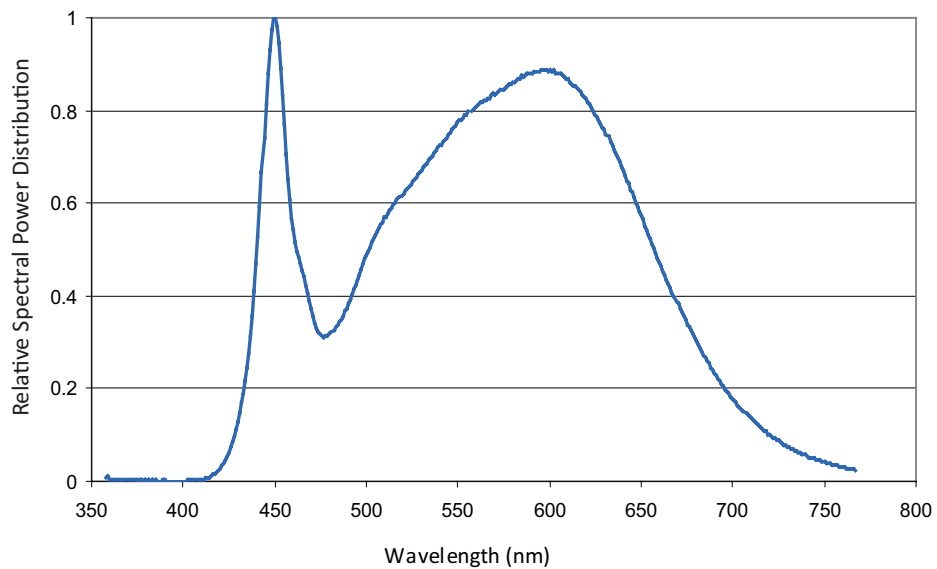


Figure 7. Color spectrum of LXM3-PW51 emitter, integrated measurement.

# Light Output Characteristics over Temperature

## All Parts at Test Current

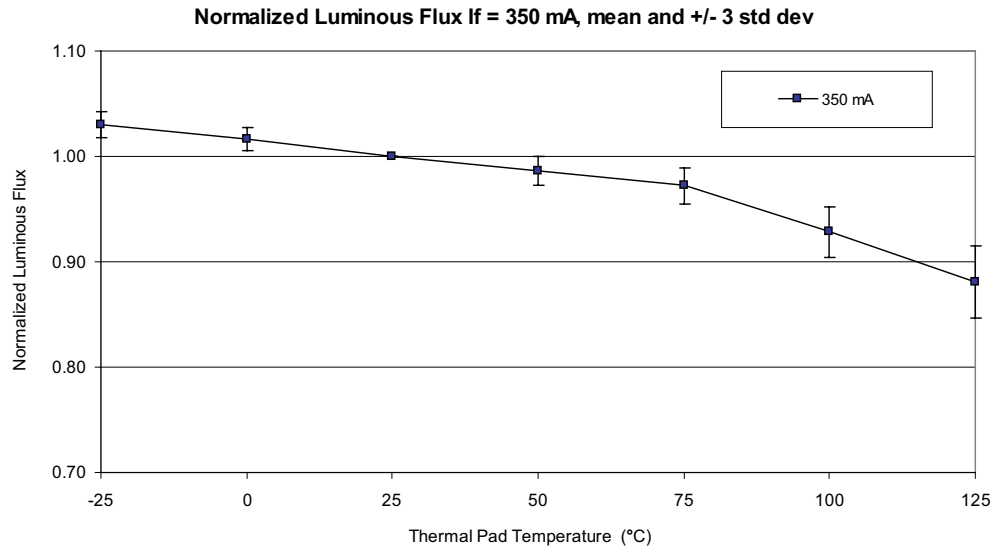


Figure 8. Relative light output vs. thermal pad temperature.

# Typical Forward Current Characteristics

## Typical Forward Current Characteristics

Thermal Pad Temperature = 25°C

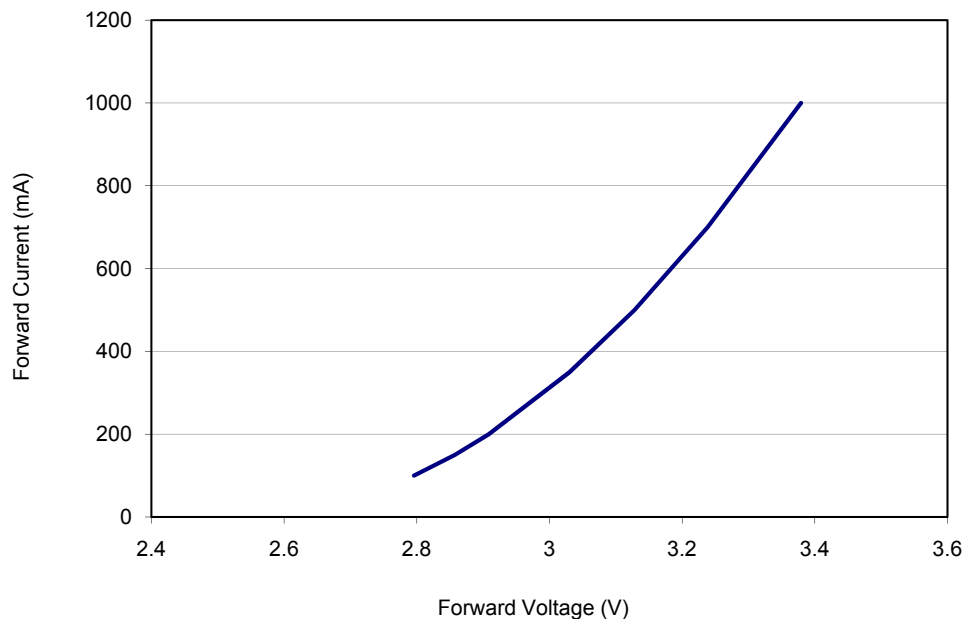


Figure 9. Forward current vs. forward voltage.

## Typical Relative Luminous Flux vs. Forward Current

Thermal Pad Temperature = 25°C

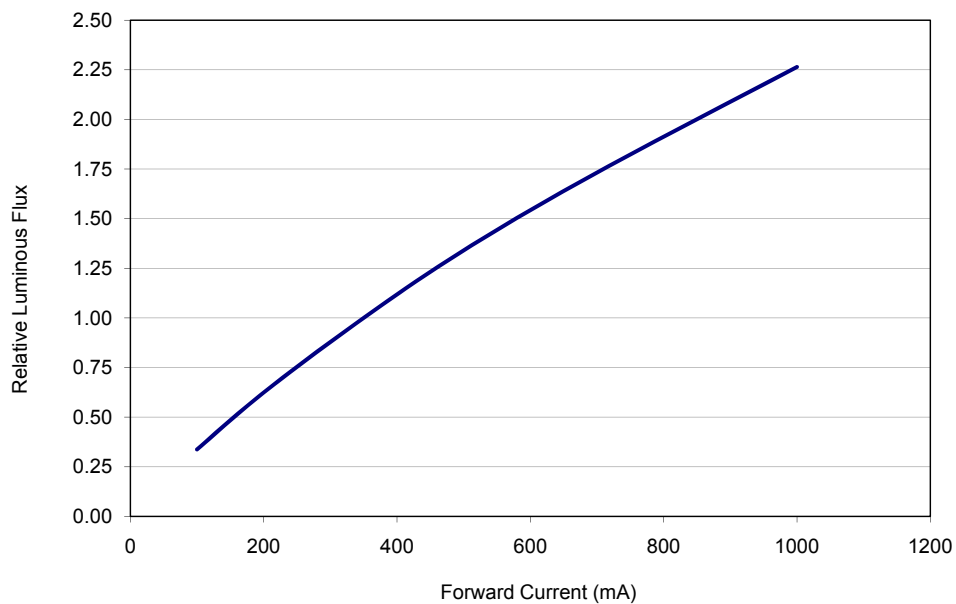


Figure 10. Typical relative luminous flux vs. forward current, thermal pad temperature = 25°C.

# Current Derating Curves

## Current Derating Curve for 350mA Drive Current

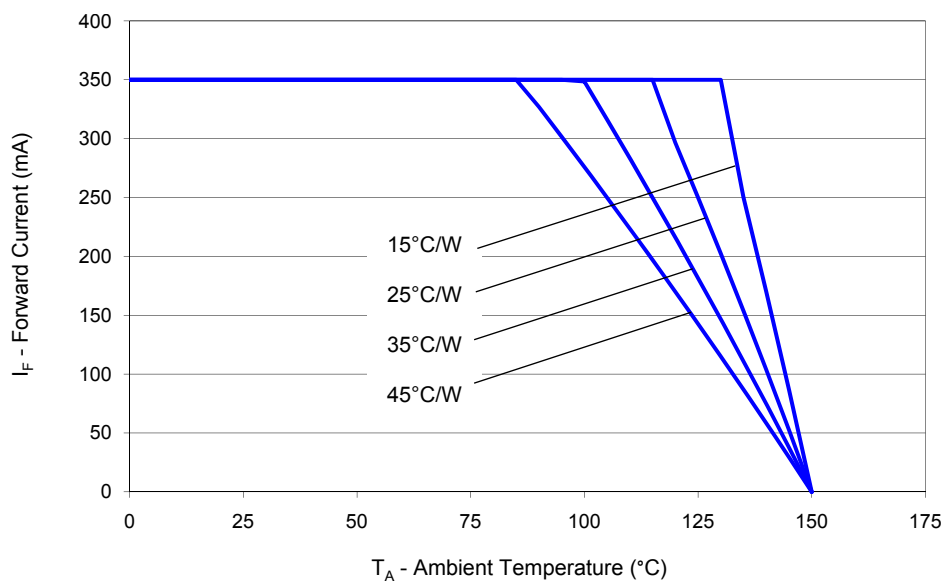


Figure 11. Maximum forward current vs. ambient temperature, based on  $T_{JMAX} = 150^\circ\text{C}$ .

## Current Derating Curve for 700mA Drive Current

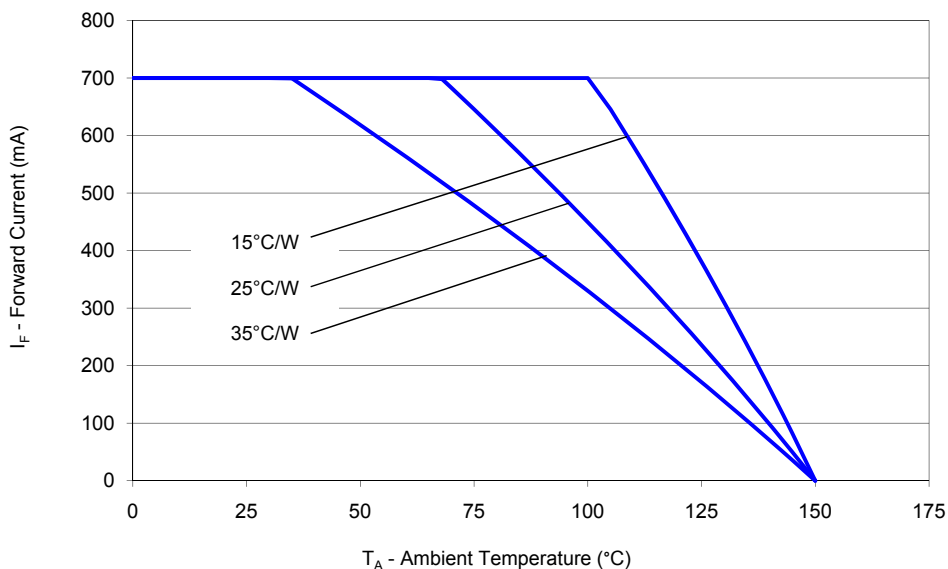


Figure 12. Maximum forward current vs. ambient temperature, based on  $T_{JMAX} = 150^\circ\text{C}$ .

# Typical Radiation Patterns

## Typical Spatial Radiation Pattern for Lambertian

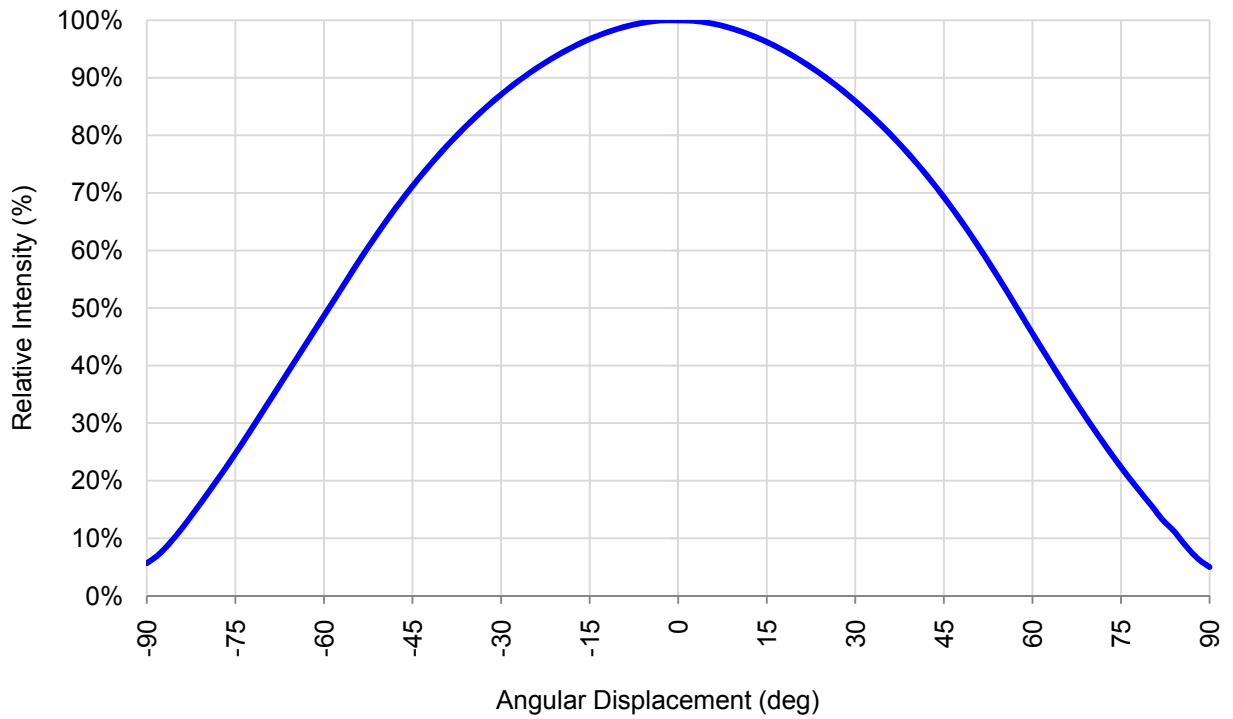


Figure 13. Typical representative spatial radiation pattern for lambertian.

## Typical Polar Radiation Pattern for Lambertian

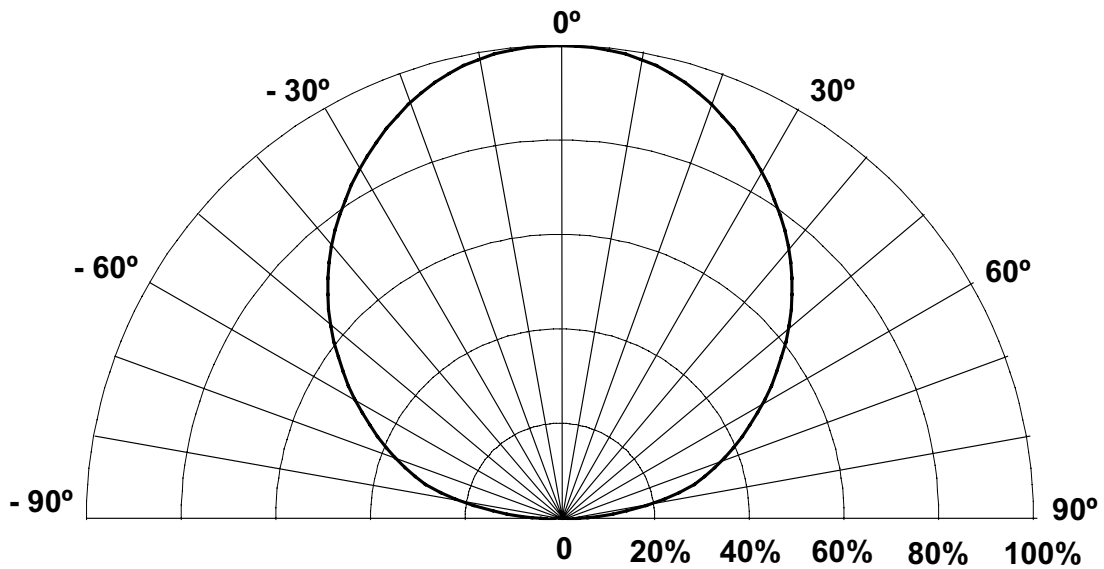


Figure 14. Typical polar radiation pattern for lambertian.

# Emitter Pocket Tape Packaging

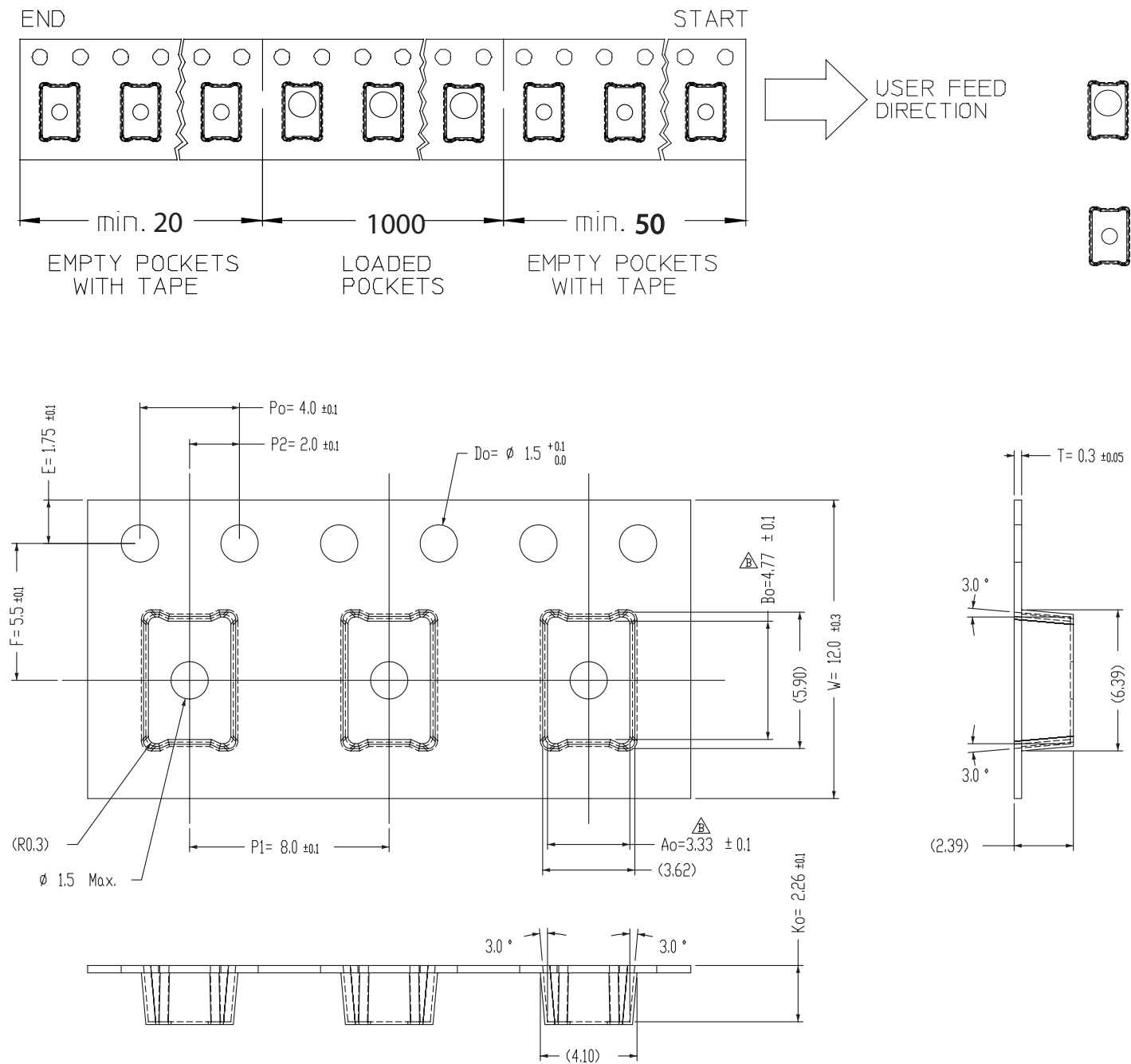


Figure 15. Emitter pocket tape packaging.

# Emitter Reel Packaging

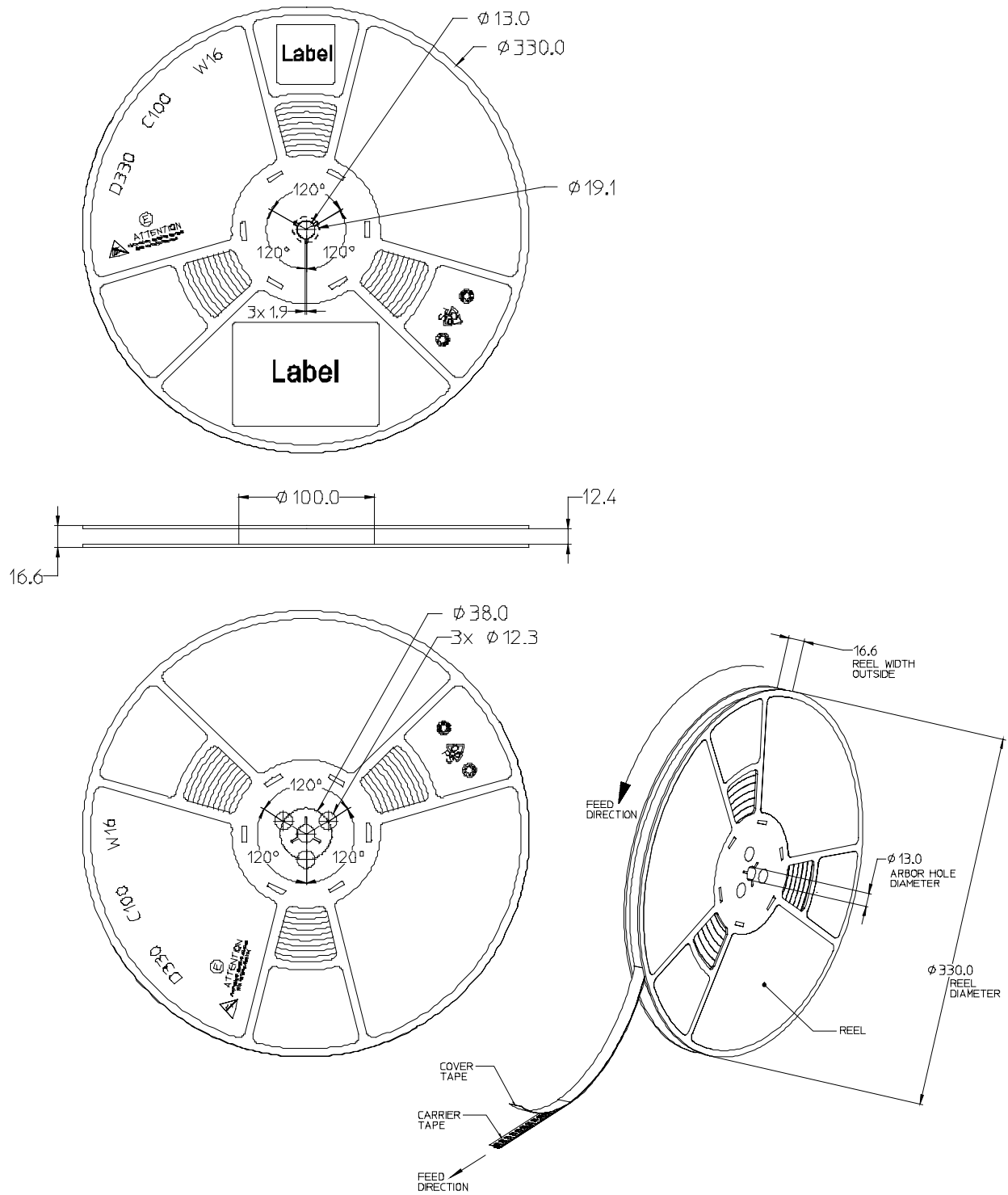


Figure 16. Emitter reel packaging.



# Product Binning and Labeling

## Purpose of Product Binning

In the manufacturing of semiconductor products, there is a variation of performance around the average values given in the technical data sheets. For this reason, Lumileds bins the LED components for luminous flux, color and forward voltage ( $V_f$ ).

## Decoding Product Bin Labeling

LUXEON Rebel emitters are labeled using a four digit alphanumeric code (CAT code) depicting the bin values for emitters packaged on a single reel. All emitters packaged within a reel are of the same 3-variable bin combination. Using these codes, it is possible to determine optimum mixing and matching of products for consistency in a given application.

Reels of 2700K, 3000K, 3500K and 4000K emitters are labeled with a four digit alphanumeric CAT code following the format below.

A B C D

- A = Flux bin (J, K, L, M etc.)
- B & C = Color bin (5A, 5B, 5C are ANSI quadrant color bins.)
- D =  $V_f$  bin (C, D, E are 0.24V forward voltage bins.)

## Luminous Flux Bins

Table 7 lists the standard photometric luminous flux bins for LUXEON Rebel emitters (tested and binned at 350mA). Although several bins are outlined, product availability in a particular bin varies by production run and by product performance.

Not all bins are available in all colors.

**Table 7. Flux Bins - All Colors**

Bin Code	Minimum Photometric Flux (lm)	Maximum Photometric Flux (lm)
H	50	60
J	60*	70
K	70**	80
L	80	90
M	90	100
N	100	110
X	110	120
P	120	130
Y	130	140
Q	140	150
R	150	160

\* 65 lm for LXM3-PW81, 66 lm for LXM3-PW71, 67 lm for LXM3-PW61

\*\* 75 lm for LXM3-PW51

# LUXEON Rebel ANSI 1/4th Quadrant Bin Structure

## LUXEON Rebel ANSI 1/4th Quadrant Bin Structure

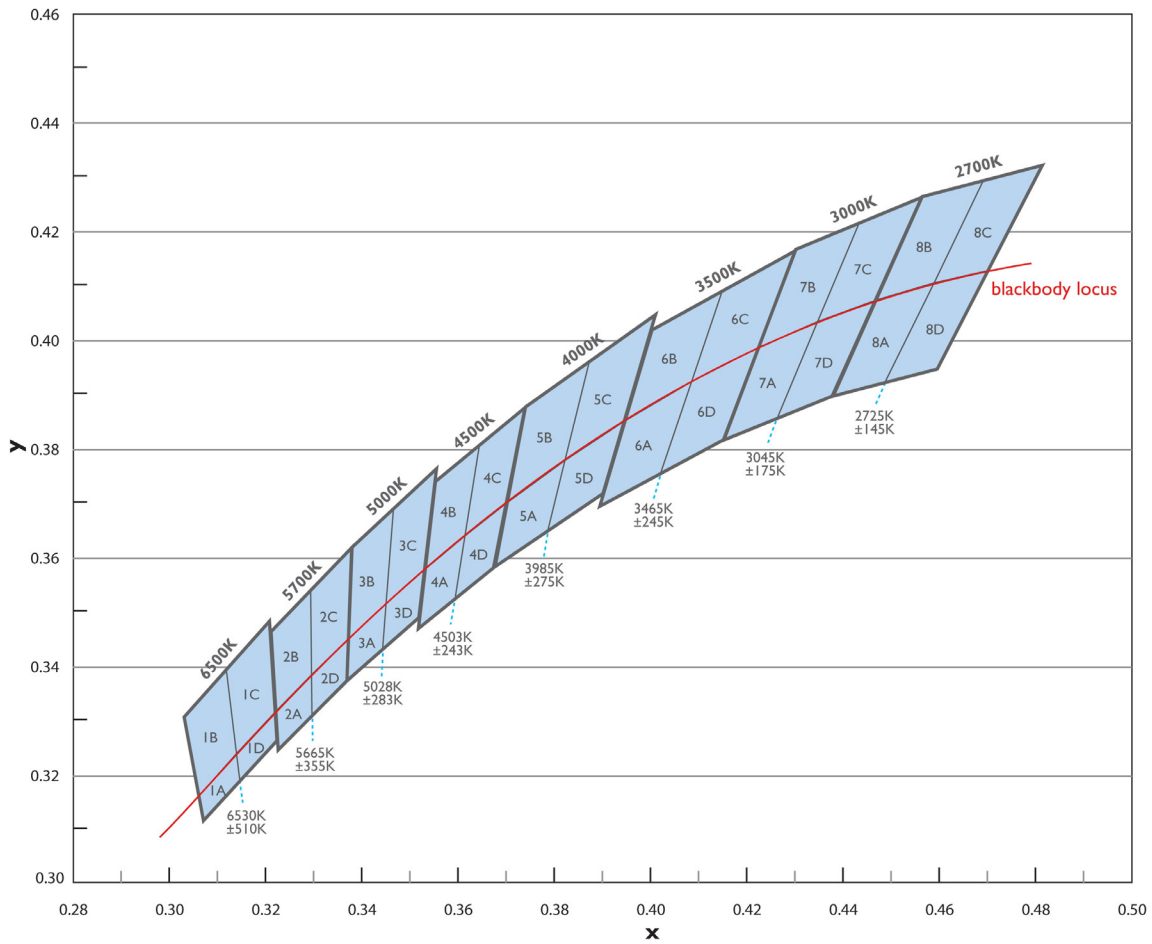


Figure 17. LUXEON Rebel ANSI 1/4th quadrant bin structure.

# LUXEON Rebel ANSI 1/4th Quadrant Bin Coordinates

LUXEON Rebel emitters are tested and binned by x,y coordinates.

32 Color Bins, CCT Range 2580K to 7040K

**Table 8. LUXEON Rebel ANSI 1/4th Quadrant Bin Coordinates**

Nominal CCT	Bin Code	x	y	Nominal CCT	Bin Code	x	y
2700K	8A	0.458614	0.410315	4000K	5A	0.381883	0.377641
		0.446470	0.407117			0.369655	0.369740
		0.437300	0.389300			0.367000	0.357800
		0.448286	0.391847			0.378297	0.364637
	8B	0.468732	0.428946		5B	0.386955	0.395809
		0.456200	0.426000			0.373600	0.387400
		0.446470	0.407117			0.369655	0.369740
		0.458614	0.410315			0.381883	0.377641
	8C	0.481300	0.431900		5C	0.400600	0.404400
		0.468732	0.428946			0.386955	0.395809
		0.458614	0.410315			0.381883	0.377641
		0.469954	0.412602			0.394131	0.384815
8D	0.469954	0.412602	5D	0.394131	0.384815		
	0.458614	0.410315		0.381883	0.377641		
	0.448286	0.391847		0.378297	0.364637		
	0.459300	0.394400		0.389800	0.371600		
3000K	7A	0.434392	0.403186	4500K	4A	0.361112	0.363778
		0.422071	0.398417			0.352638	0.357500
		0.414700	0.381400			0.351200	0.346500
		0.425959	0.385336			0.359037	0.352105
	7B	0.442994	0.421230		4B	0.364112	0.380435
		0.429900	0.416500			0.354800	0.373600
		0.422071	0.398417			0.352638	0.357500
		0.434392	0.403186			0.361112	0.363778
	7C	0.456200	0.426000		4C	0.373600	0.387400
		0.442994	0.421230			0.364112	0.380435
		0.434392	0.403186			0.361112	0.363778
		0.446470	0.407117			0.369655	0.369740
7D	0.446470	0.407117	4D	0.369655	0.369740		
	0.434392	0.403186		0.361112	0.363778		
	0.425959	0.385336		0.359037	0.352105		
	0.437300	0.389300		0.367000	0.357800		
3500K	6A	0.408216	0.392153	5000K	3A	0.344719	0.351301
		0.394131	0.384815			0.336916	0.344873
		0.388900	0.369000			0.336600	0.336900
		0.401706	0.375155			0.343985	0.342749
	6B	0.414622	0.408937		3B	0.346260	0.368726
		0.399600	0.401500			0.337600	0.361600
		0.394131	0.384815			0.336916	0.344873
		0.408216	0.392153			0.344719	0.351301
	6C	0.429900	0.416500		3C	0.355100	0.376000
		0.414622	0.408937			0.346260	0.368726
		0.408216	0.392153			0.344719	0.351301
		0.422071	0.398417			0.352638	0.357500
6D	0.422071	0.398417	3D	0.352638	0.357500		
	0.408216	0.392153		0.344719	0.351301		
	0.401706	0.375155		0.343985	0.342749		
	0.414700	0.381400		0.351500	0.348700		

Table 8 continued on next page.

**Table 8. LUXEON Rebel ANSI 1/4th Quadrant Bin Coordinates, Continued**

Nominal CCT	Bin Code	x	y	Nominal CCT	Bin Code	x	y
5700K	2A	0.329231	0.338226	6500K	1A	0.313640	0.323739
		0.321708	0.331406			0.305852	0.315982
		0.322200	0.324300			0.306800	0.311300
		0.329330	0.330539			0.314359	0.318612
	2B	0.329053	0.353812		1B	0.311529	0.339129
		0.320700	0.346200			0.302800	0.330400
		0.321708	0.331406			0.305852	0.315982
		0.329231	0.338226			0.313640	0.323739
	2C	0.337600	0.361600		1C	0.320500	0.348100
		0.329053	0.353812			0.311529	0.339129
		0.329231	0.338226			0.313640	0.323739
		0.336916	0.344873			0.321708	0.331406
2D	0.336916	0.344873	1D	0.321708	0.331406		
	0.329231	0.338226		0.313640	0.323739		
	0.329330	0.330539		0.314359	0.318612		
	0.336600	0.336900		0.322100	0.326100		

Notes for Table 8:

- Lumileds maintains a tester tolerance of  $\pm 0.005$  on x, y color coordinates.

## Forward Voltage Bins

Table 9 lists minimum and maximum  $V_f$  bin values per emitter. Although several bins are outlined, product availability in a particular bin varies by production run and by product performance.

**Table 9.  $V_f$  Bins**

Bin Code	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
B	2.55	2.79
C	2.79	3.03
D	3.03	3.27
E	3.27	3.51

# About Lumileds

Lumileds is the light engine leader, delivering innovation, quality, and reliability.

For 100 years, Lumileds commitment to innovation has helped customers pioneer breakthrough products in the automotive, consumer and illumination markets.

Lumileds is shaping the future of light with our LEDs and automotive lamps, and helping our customers illuminate how people see the world around them.

To learn more about our portfolio of light engines visit [www.lumileds.com](http://www.lumileds.com).



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