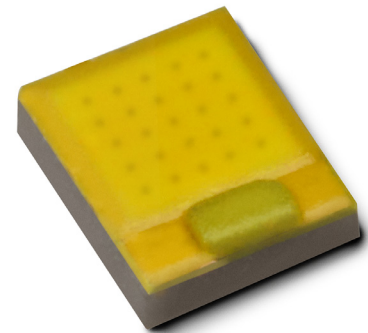




# LUXEON Z ES

Extreme flux density in a micro footprint package for precise optical control

LUXEON Z ES is a high power 1.6mm x 2.0mm LED that enables never before seen color consistency, luminance, flux density and design flexibility for lighting solutions. It is the first ever 1-step MacAdam ellipse warm white LED. LUXEON Z ES is undomed, a feature that provides unmatched optical flexibility for precise beam angle control. Tested and binned at application conditions, 85°C, LUXEON Z ES emitters are an ideal choice for indoor and outdoor light sources requiring superior beam angles, higher efficacy and lower costs.



## FEATURES AND BENEFITS

Micro footprint enables close packaging

Undomed design allows precise optical control

1-, 3- and 5-step MacAdam ellipse: *Freedom from Binning* enabling color consistency

LM-80 test report available

## PRIMARY APPLICATIONS

Architectural

Downlights

Lamps

Outdoor

Spotlights

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# General Product Information

## Product Test Conditions

LUXEON Z ES are tested and binned with a drive current of 700mA for 3V part or 40mA for 48V part at a junction temperature,  $T_j$ , of 85°C.

## Part Number Nomenclature

Part numbers for LUXEON Z ES follow the convention below:

L X Z **A - B C D E - F**

Where:

- A** - designates voltage (2=3V and H=48V)
- B C** - designates nominal ANSI CCT or color (eg. 27=2700K, 30=3000K and PR=Royal Blue)
- D E** - designates minimum CRI performance (70=70CRI, 80=80CRI, 90=90CRI, 02=Royal Blue)
- F** - designates white color space definition (1=1 SDCM, 3=3 SDCM and 5=5 SDCM, not used for Royal Blue)

Therefore, the following part number is used for a LUXEON Z ES White 3V, 3000K 80CRI LED, which is binned within a 3-step MacAdam ellipse:

L X Z **2 - 3 0 8 0 - 3**

## Lumen Maintenance

Please contact your local Sales Representative or Lumileds Technical Solutions Manager for more information about the long-term performance of this product.

## Environmental Compliance

Lumileds LLC is committed to providing environmentally friendly products to the solid-state lighting market. LUXEON Z ES is compliant to the European Union directives on the restriction of hazardous substances in electronic equipment, namely the RoHS Directive 2011/65/EU and REACH Regulation (EC) 1907/2006. Lumileds LLC will not intentionally add the following restricted materials to its products: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

# Performance Characteristics

## Product Selection Guide

Table 1a. Product performance of LUXEON Z ES 3V at 700mA and 350mA,  $T_j=85^\circ\text{C}$ .

NOMINAL CCT	MINIMUM CRI	LUMINOUS FLUX <sup>(1)</sup> (lm)		TYPICAL LUMINOUS EFFICACY (lm/W)	TYPICAL LUMINOUS FLUX (lm)	TYPICAL LUMINOUS EFFICACY (lm/W)	PART NUMBER <sup>(2)</sup>
		MINIMUM	TYPICAL				
		700mA			350mA		
4000K	70	220	240	122	132	139	LXZ2-4070
5000K	70	220	245	125	135	142	LXZ2-5070
5700K	70	220	245	125	135	142	LXZ2-5770
6500K	70	220	245	125	135	142	LXZ2-6570
2200K	80	140	150	77	83	87	LXZ2-2280-x
2700K	80	170	185	94	102	107	LXZ2-2780-x
3000K	80	180	195	99	107	113	LXZ2-3080-x
3500K	80	190	205	105	113	118	LXZ2-3580-x
4000K	80	190	220	112	121	127	LXZ2-4080-x
5000K	80	190	220	112	121	127	LXZ2-5080-x
2700K	90	140	160	82	88	92	LXZ2-2790-x
3000K	90	150	170	87	94	98	LXZ2-3090-x
3500K	90	150	171	87	94	98	LXZ2-3590-x
4000K	90	150	180	92	99	104	LXZ2-4090-x
5700K	90	170	190	97	105	110	LXZ2-5790-x

Table 1b. Product performance of LUXEON Z ES 48V at 40mA and 20mA,  $T_j=85^\circ\text{C}$ .

NOMINAL CCT	MINIMUM CRI	LUMINOUS FLUX <sup>(1)</sup> (lm)		TYPICAL LUMINOUS EFFICACY (lm/W)	TYPICAL LUMINOUS FLUX (lm)	TYPICAL LUMINOUS EFFICACY (lm/W)	PART NUMBER <sup>(2)</sup>
		MINIMUM	TYPICAL				
		40mA			20mA		
2700K	80	150	165	83	91	93	LXZH-2780-x

Table 1c. Product performance of LUXEON Z ES Royal Blue at 700mA,  $T_j=85^\circ\text{C}$ .

COLOR	RADIOMETRIC POWER (mW)		TYPICAL RADIANT EFFICIENCY (%)	PART NUMBER
	MINIMUM	TYPICAL		
Royal Blue	800	850	45%	LXZ2-PR02

**Notes for Tables 1a, 1b and 1c:**

- Lumileds maintains a tolerance of  $\pm 6.5\%$  on both luminous flux and radiometric power and  $\pm 2$  on CRI measurements.
- In the part number the -x is the designation for the white color space requirement. On 80CRI and 90CRI versions -1 designates 1 SDCM, -3 designates 3 SDCM, -5 designates 5 SDCM. 70 CRI parts or lower will not have a SDCM designation and all parts are binned within a 5 step SDCM.

# Optical Characteristics

Table 2. Optical characteristics for LUXEON Z ES at 700mA.

PART NUMBER	TYPICAL TOTAL INCLUDED ANGLE <sup>[1]</sup>	TYPICAL VIEWING ANGLE <sup>[2]</sup>
LXZ2-xxxx	140°	116°
LXZ2-xxxx-x	140°	116°
LXZH-xxxx-x	140°	116°
LXZ2-PRO2	140°	120°

**Notes for Table 2:**

1. Total angle at which 90% of total luminous flux is captured.
2. Viewing angle is the off axis angle from the LED centerline where the luminous intensity is ½ of the peak value.

# Electrical and Thermal Characteristics

Table 3a. Electrical and thermal characteristics for LUXEON Z ES at 700mA.

PART NUMBER	FORWARD VOLTAGE (V)			TYPICAL TEMPERATURE COEFFICIENT OF FORWARD VOLTAGE (mV/°C)	TYPICAL THERMAL RESISTANCE JUNCTION TO SOLDER PAD (°C/W)
	MINIMUM	TYPICAL	MAXIMUM		
LXZ2-xxxx	2.5	2.8	3.25	-1.6	3
LXZ2-xxxx-x	2.5	2.8	3.25	-1.6	3

**Notes for Table 3a:**

1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
2. Measured between 25°C and 110°C.

Table 3b. Forward voltage and typical thermal resistance for LUXEON Z ES at 40mA.

PART NUMBER	FORWARD VOLTAGE (V)			TYPICAL TEMPERATURE COEFFICIENT OF FORWARD VOLTAGE (mV/°C)	TYPICAL THERMAL RESISTANCE JUNCTION TO SOLDER PAD (°C/W)
	MINIMUM	TYPICAL	MAXIMUM		
LXZH-xxxx-x	48.5	49.0	50.5	-30	3

**Notes for Table 3b:**

1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
2. Measured between 25°C and 110°C.

# Absolute Maximum Ratings

Table 4. Absolute maximum ratings for LUXEON Z ES.

PARAMETER	MAXIMUM PERFORMANCE
DC Forward Current <sup>[1,2]</sup>	45mA for LXZH-xxxx-x 1200mA for LXZ2-xxxx
Peak Pulsed Forward Current <sup>[1,3]</sup>	65mA for LXZH-xxxx-x 1350mA for LXZ2-xxxx
LED Junction Temperature <sup>[1]</sup> (DC & Pulse)	135°C for LXZx-xxxx
ESD Sensitivity	Class 3B
Operating Case Temperature	-40°C to 135°C
Storage Temperature	-40°C to 135°C
Soldering Temperature	JEDEC 020c 260°C
Allowable Reflow Cycles	3
Reverse Voltage ( $V_{reverse}$ ) <sup>[4, 5]</sup>	LUXEON LEDs are not designed to be driven in reverse bias

**Notes for Table 4:**

1. Proper current derating must be observed to maintain junction temperature below the maximum.
2. Residual periodic variations due to power conversion from alternating current (AC) to direct current (DC), also called "ripple," are acceptable if the following conditions are met:
  - The frequency of the ripple current is 100Hz or higher
  - The average current for each cycle does not exceed the maximum allowable DC forward current
  - The maximum amplitude of the ripple does not exceed the maximum peak pulsed forward current
3. Pulsed operation with the maximum peak pulsed forward current is acceptable if the pulse on-time is  $\leq 5$ ms per cycle and the duty cycle is  $\leq 50\%$ .
4. Transient reverse voltages and surge currents due to electrical switching or supply interruptions are acceptable if these events do not last for more than 10ms, the amplitude of the reverse voltage does not exceed 5V and the reverse current is less than 200uA.
5. A maximum 5V reverse voltage for up to 10s is an acceptable beginning of life, one time, test.

# Characteristic Curves

## Spectral Power Distribution Characteristics

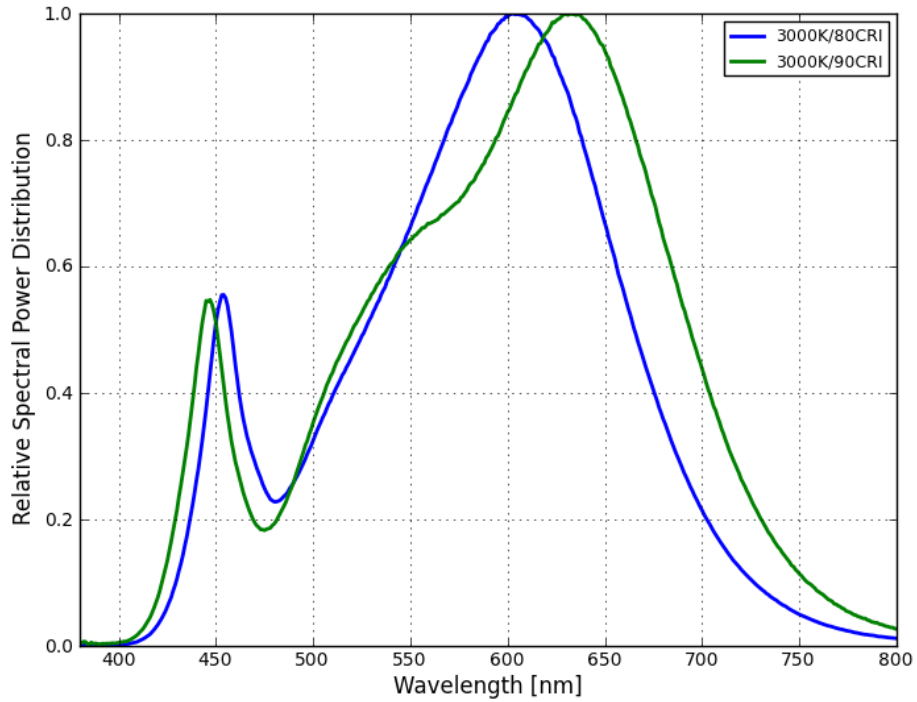


Figure 1: Typical normalized power vs. wavelength for LXZx-xxxx at test current,  $T_j=85^\circ\text{C}$ .

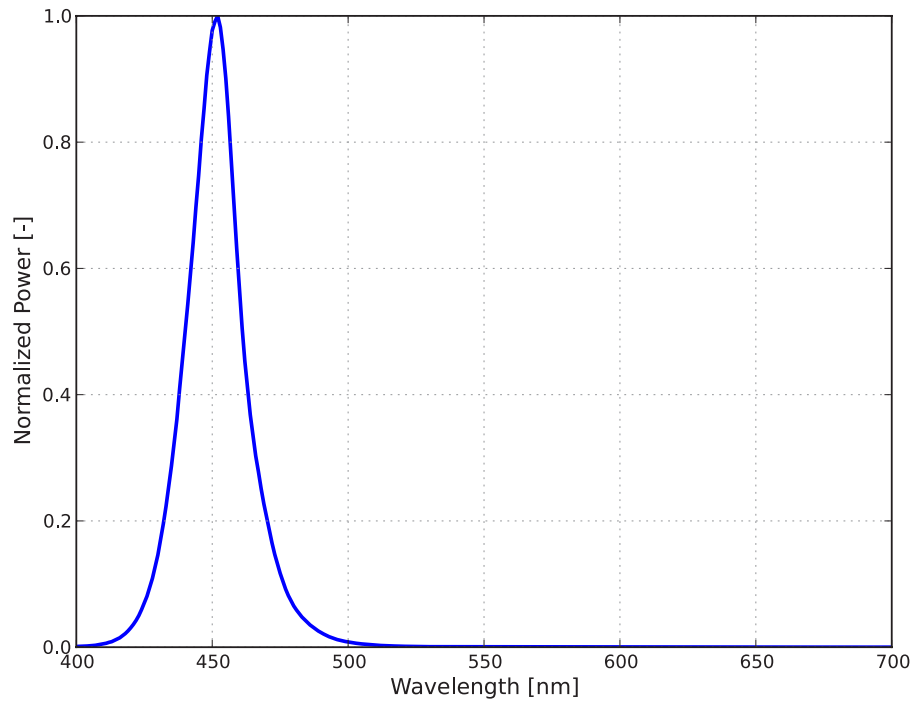


Figure 2: Typical normalized power vs. wavelength for LXZ2-PR02 at 700mA,  $T_j=85^\circ\text{C}$ .

# Light Output Characteristics

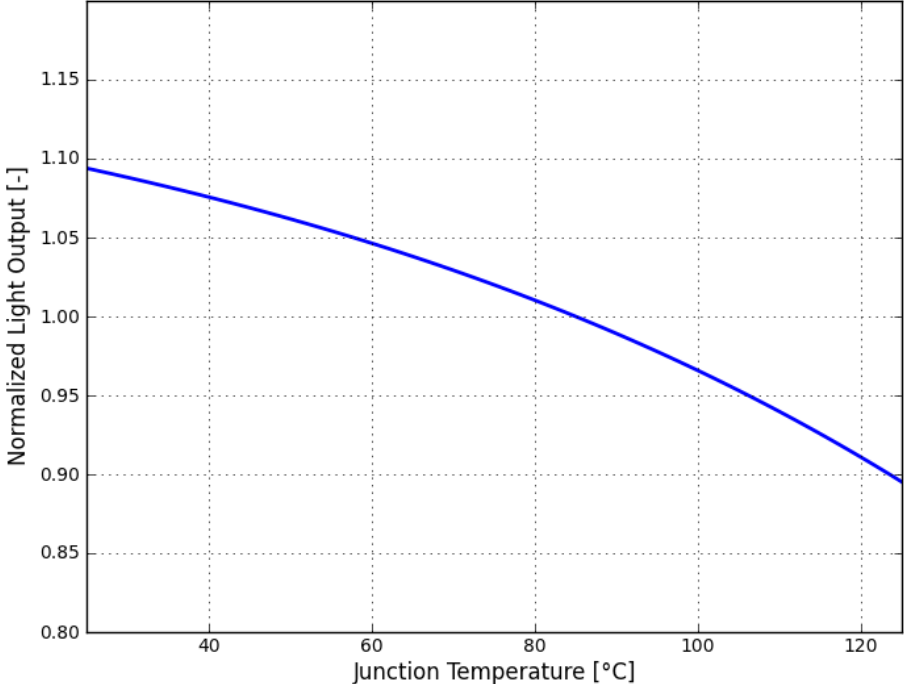


Figure 3a: Typical normalized light output vs. junction temperature for LXZx-xxxx, at test current.

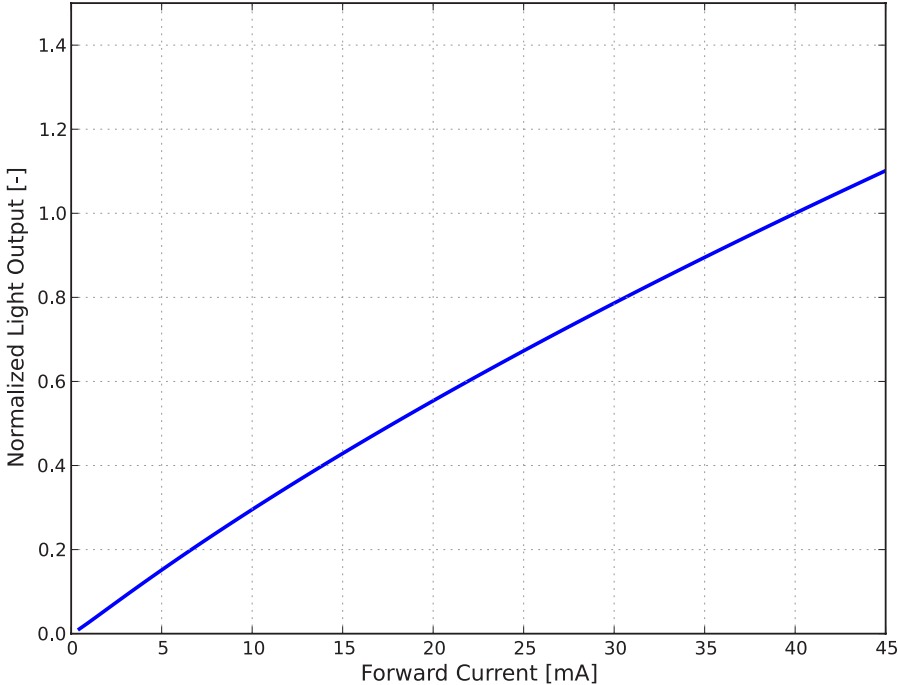


Figure 3b: Typical normalized light output vs. forward current for LXZH-xxxx-x, Tj=85°C.



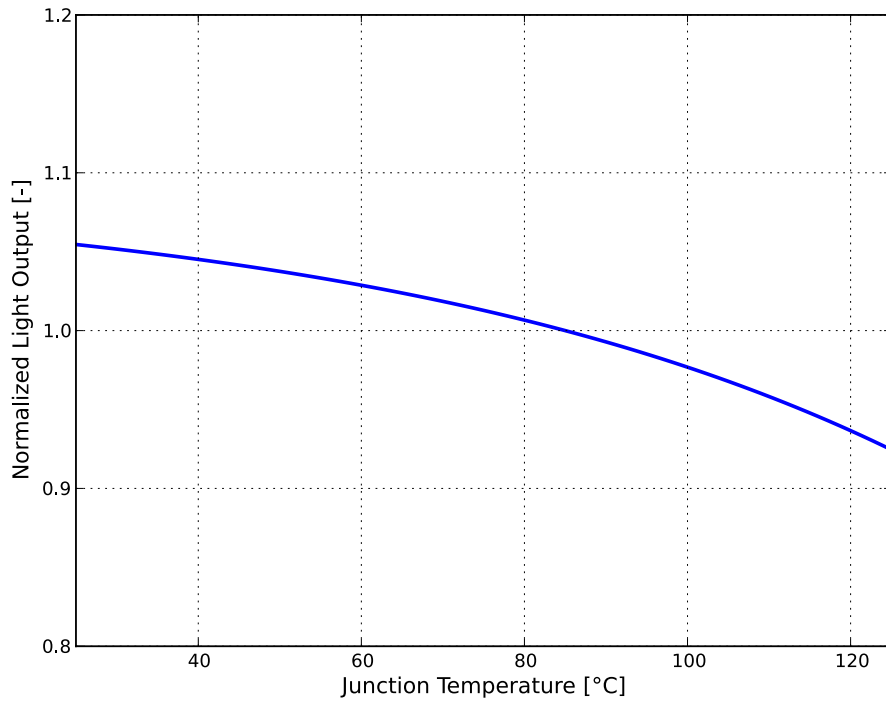


Figure 4a: Typical normalized light output vs. junction temperature for LXZ2-PR02, at test current.

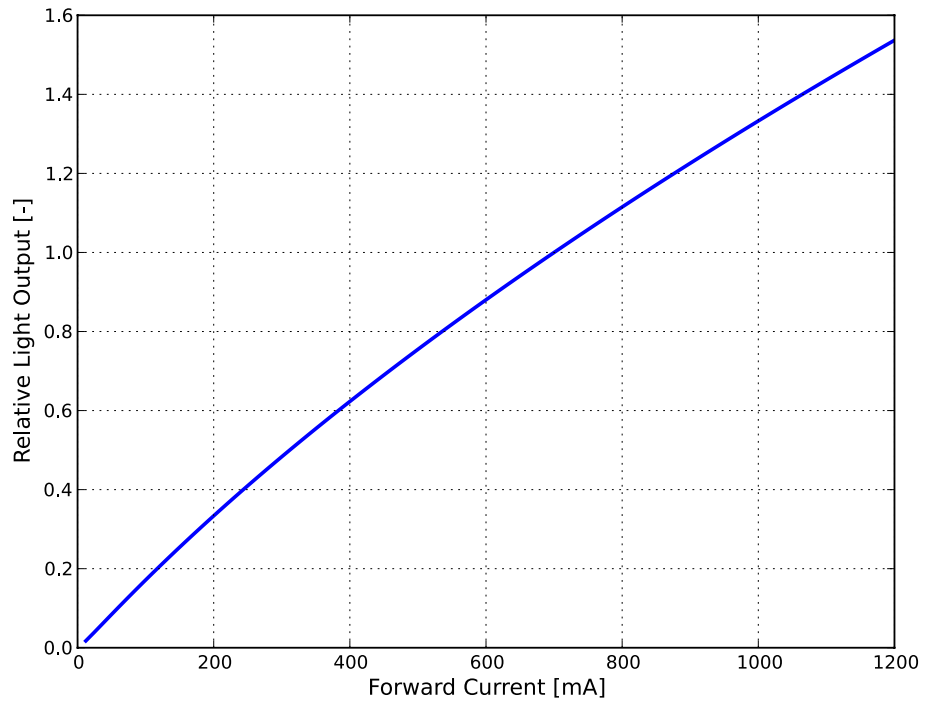


Figure 4b: Typical normalized light output vs. forward current for LXZx-xxxx,  $T_j=85^\circ\text{C}$ .

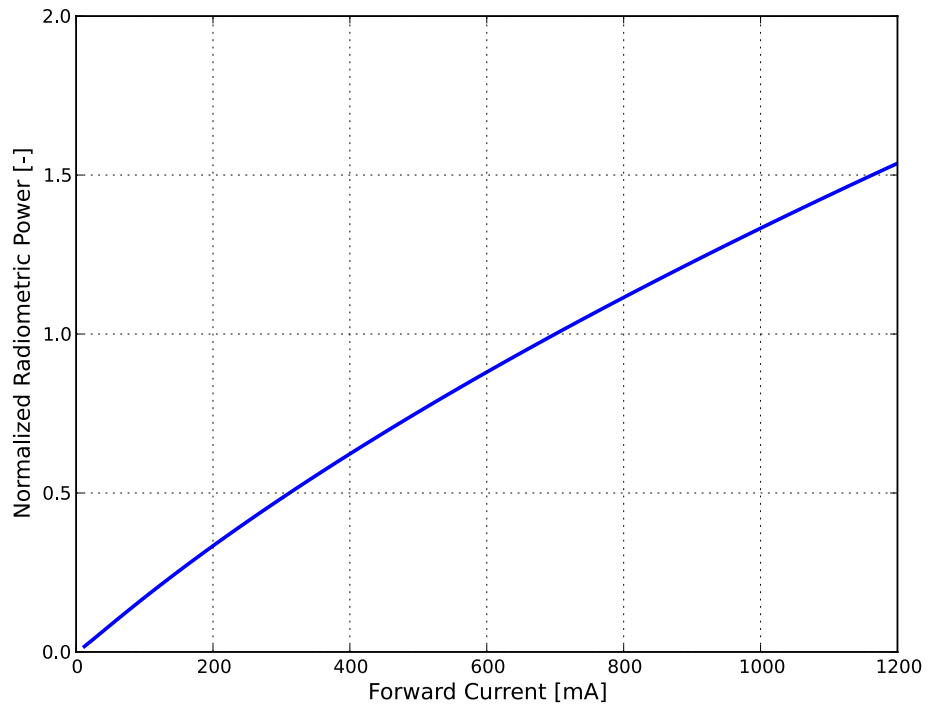


Figure 4c: Normalized radiometric power vs. forward current for LXZ2-PR02,  $T_j=85^\circ\text{C}$ .

# Forward Current Characteristics

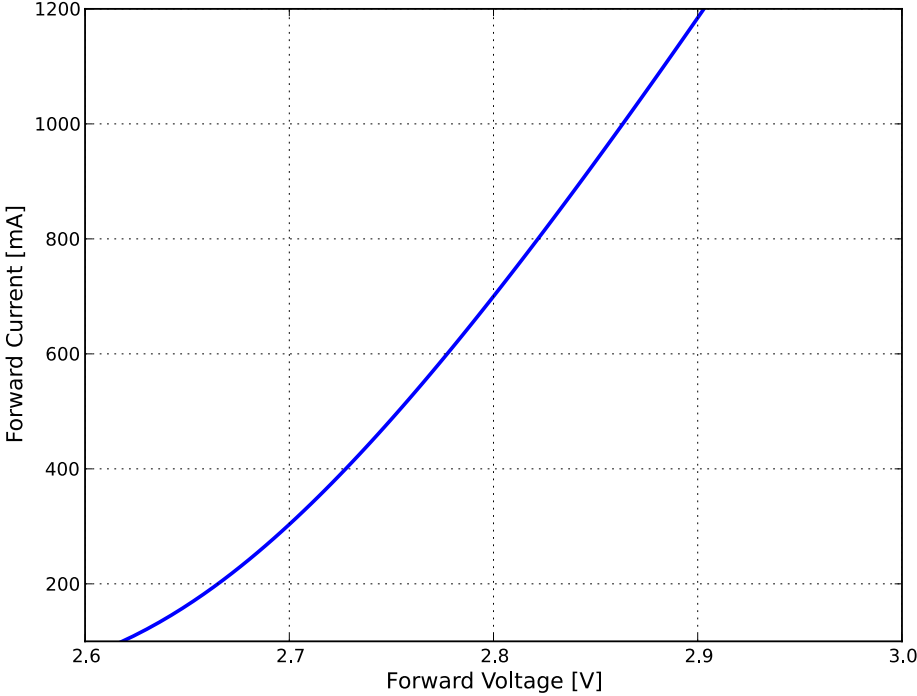


Figure 5a: Typical forward current vs. forward voltage for LXZx-xxxx,  $T_j=85^\circ\text{C}$ .

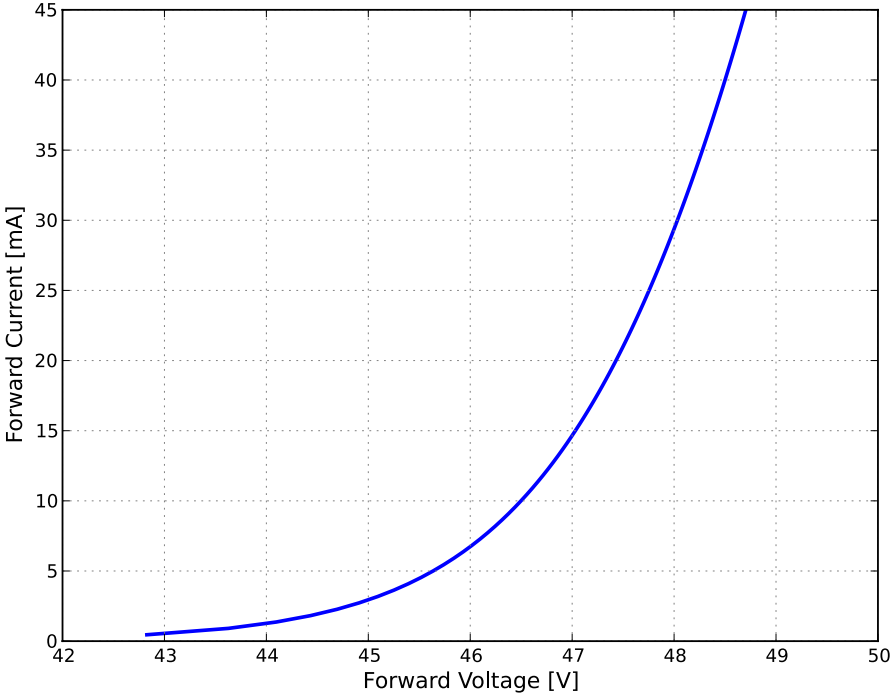


Figure 5b: Typical forward current vs. forward voltage for LXZH-2780-x,  $T_j=85^\circ\text{C}$ .

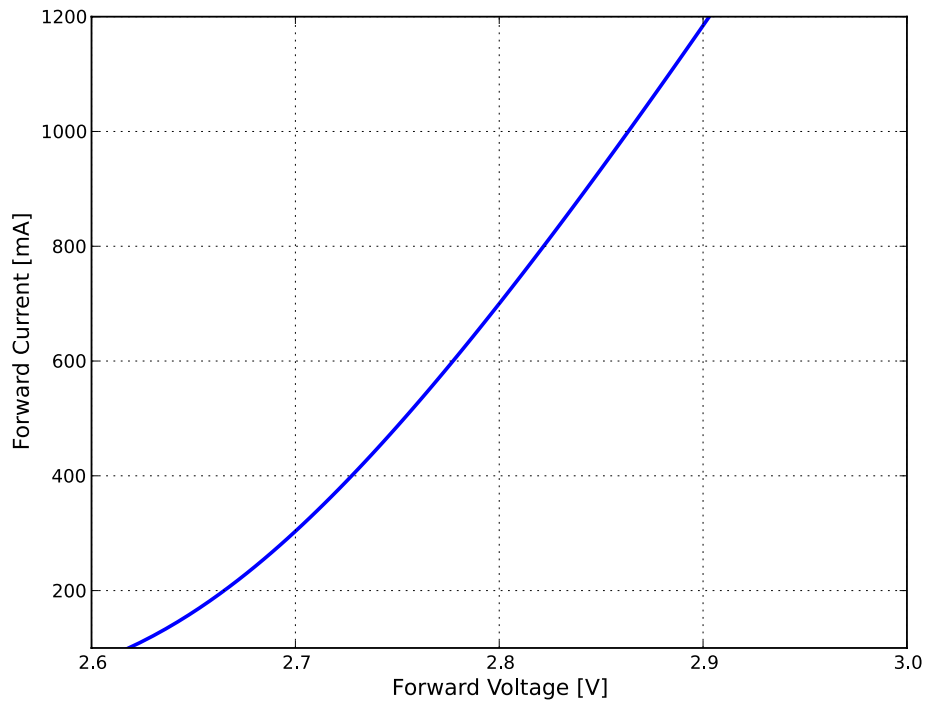


Figure 5c: Typical forward current vs. forward voltage for LXZ2-PR02, T<sub>j</sub>=85°C.

## Radiation Pattern Characteristics

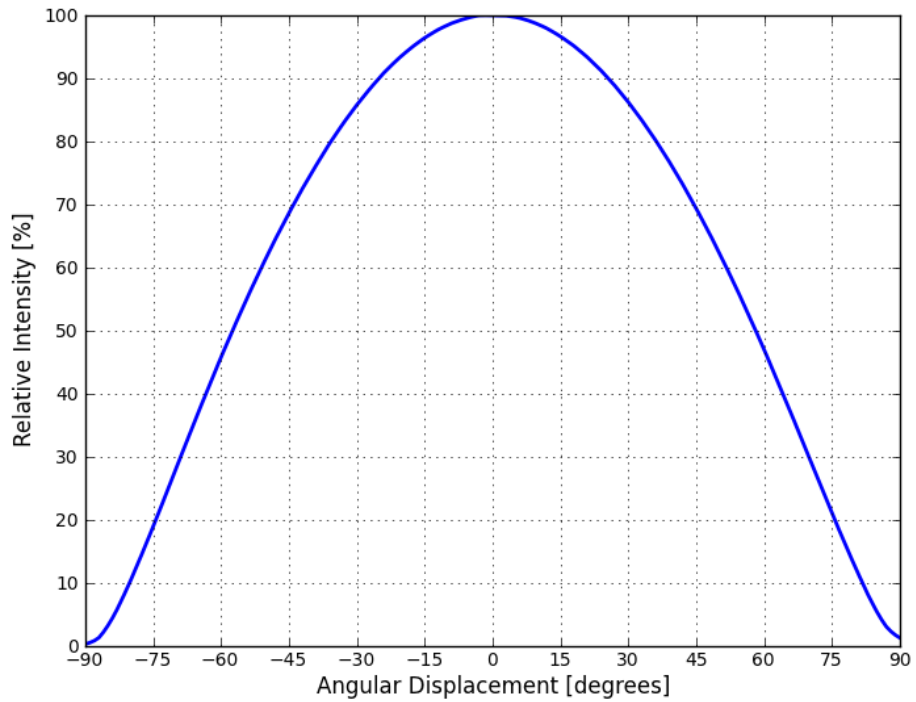


Figure 6a: Typical radiation pattern for LXZx-xxxx (white only) at test current.

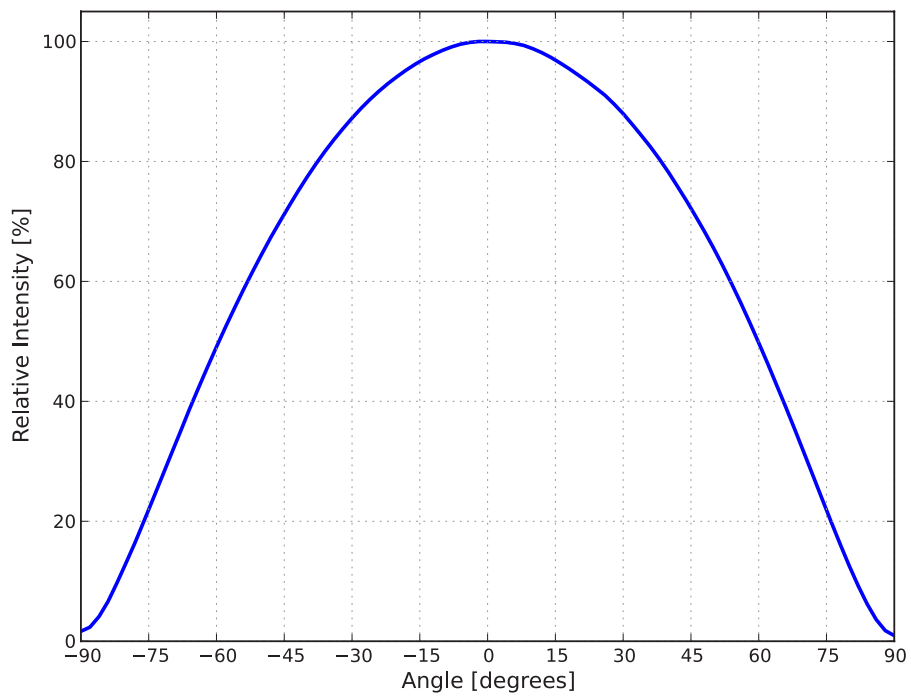


Figure 6b: Typical radiation pattern for LXZ2-PR02 at test current.

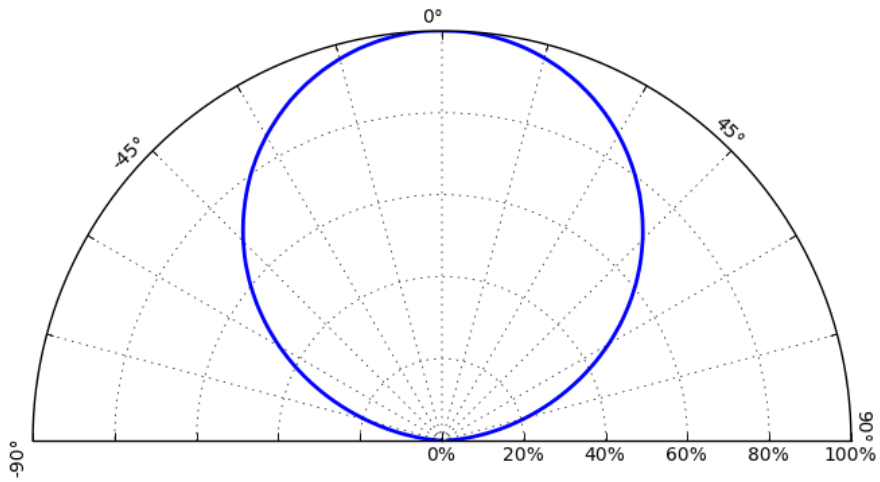


Figure 7a: Typical polar radiation pattern for LXZx-xxxx (white only) at test current.

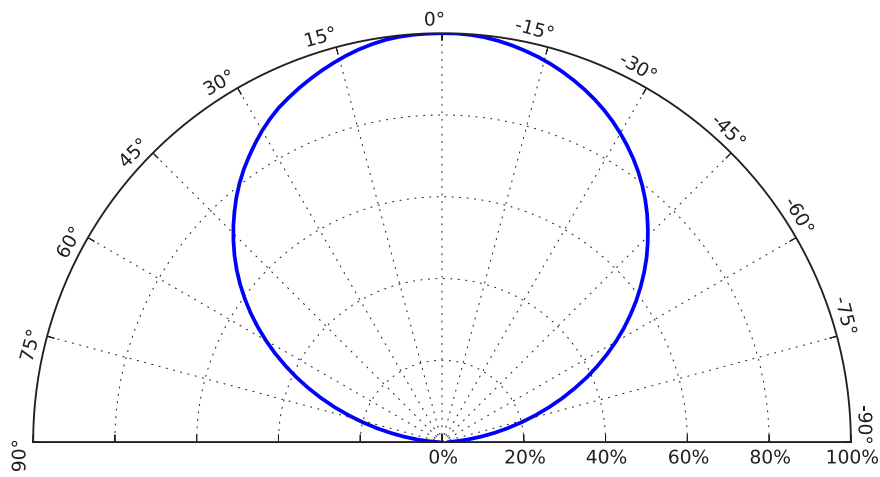


Figure 7b: Typical polar radiation pattern for LXZ2-PR02 at test current.

# Product Bin and Labeling Definitions

## Decoding Product Bin Labeling

In the manufacturing of semiconductor products, there are variations in performance around the average values given in the technical datasheet. For this reason, Lumileds bins LED components for luminous flux or radiometric power, color point, peak or dominant wavelength and forward voltage.

LUXEON Z ES White LEDs are labeled using a 4-digit alphanumeric CAT code following the format below.

### A B C D

- A** – designates luminous flux/radiometric power bin (example: L=200 to 210 lumens, M=210 to 220 lumens)
- B C** – designates white color bins (example: 5A, 5B, 5C, 5D, 3U, 3L, 10 for 3000K parts)
- D** – designates forward voltage bin (example: P=2.5 to 2.75V, R=2.75 to 3.00V)

Therefore, a LUXEON Z ES white LED with a lumen range of 200 to 210, color bin of 5D and a forward voltage range of 2.5 to 2.75V has the following CAT code:

### L 5 D P

LUXEON Z ES Royal Blue LEDs are labeled using a 3-digit alphanumeric CAT code following the format below.

### A B C

- A** – designates luminous flux/radiometric power bin (example: L=200 to 210 lumens, M=210 to 220 lumens)
- B** – designates Royal Blue peak wavelength bins (example: 3 for peak wavelength of 440nm to 445nm)
- C** – designates forward voltage bin (example: P=2.5 to 2.75V, R=2.75 to 3.00V)

Therefore, a LUXEON Z ES Royal Blue with a radiometric power of 1000mW to 1050mW, peak wavelength bin of 3 and a forward voltage range of 2.5 to 2.75V has the following CAT code:

### Q 3 P

## Luminous Flux Bins

Table 5 lists the standard photometric luminous flux bins for LUXEON Z ES emitters. 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 CCTs.

**Table 5. Luminous flux bin definitions for LUXEON Z ES.**

BIN	LUMINOUS FLUX (lm)	
	MINIMUM	MAXIMUM
D	130	140
E	140	150
F	150	160
G	160	170
H	170	180
J	180	190
K	190	200
L	200	210
M	210	220
N	220	230
P	230	240
Q	240	250
R	250	260
S	260	270

**Notes for Table 5:**

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux measurements.

## Radiometric Power Bins

**Table 6. Radiometric power bin definitions for LXZ2-PR02.**

BIN CODE	RADIOMETRIC POWER (mW)	
	MINIMUM	MAXIMUM
L	800	850
M	850	900
N	900	950
P	950	1000
Q	1000	1050
R	1050	1100
S	1100	1150

**Notes for Table 6:**

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  on radiometric power measurements.



# Color Bin Definition

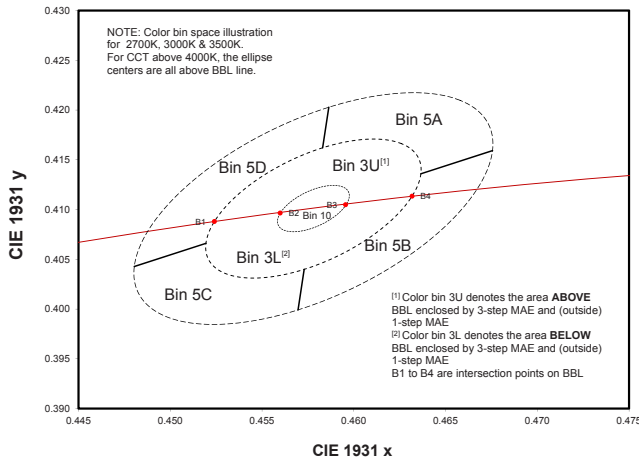


Figure 8: Color space definition for LUXEON Z ES.

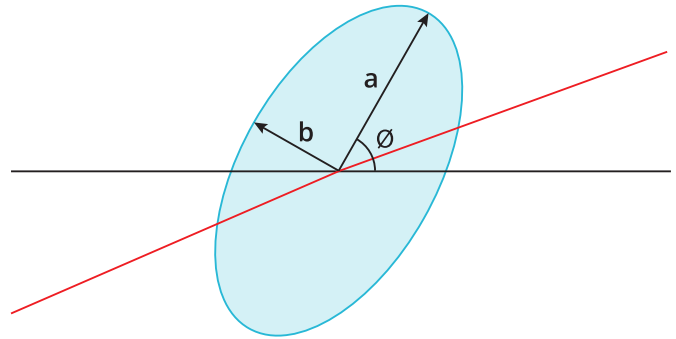


Figure 9: 1-, 3- and 5-step MacAdam ellipse illustration for Table 7.

Table 7. 1-, 3- and 5-step MacAdam ellipse color bin definitions for LUXEON Z ES.

NOMINAL CCT	COLOR SPACE <sup>[1]</sup>	CENTER POINT <sup>[2]</sup> (cx, cy)	MAJOR AXIS, a	MINOR AXIS, b	ELLIPSE ROTATION
2200K	Single 1-step MacAdam ellipse	(0.5020, 0.4156)	0.00287	0.00132	49.27°
2700K	Single 1-step MacAdam ellipse	(0.4578, 0.4101)	0.00270	0.00140	53.70°
3000K	Single 1-step MacAdam ellipse	(0.4338, 0.4030)	0.00278	0.00136	53.22°
3500K	Single 1-step MacAdam ellipse	(0.4073, 0.3917)	0.00309	0.00138	54.00°
2200K	Single 3-step MacAdam ellipse	(0.5020, 0.4156)	0.00863	0.00398	49.27°
2700K	Single 3-step MacAdam ellipse	(0.4578, 0.4101)	0.00810	0.00420	53.70°
3000K	Single 3-step MacAdam ellipse	(0.4338, 0.4030)	0.00834	0.00408	53.20°
3500K	Single 3-step MacAdam ellipse	(0.4073, 0.3917)	0.00927	0.00414	54.0°
4000K	Single 3-step MacAdam ellipse	(0.3818, 0.3797)	0.00939	0.00402	53.70°
5000K	Single 3-step MacAdam ellipse	(0.3447, 0.3553)	0.00822	0.00354	59.60°
2200K	Single 5-step MacAdam ellipse	(0.5020, 0.4156)	0.01438	0.00663	49.27°
2700K	Single 5-step MacAdam ellipse	(0.4578, 0.4101)	0.01350	0.00700	53.70°
3000K	Single 5-step MacAdam ellipse	(0.4338, 0.4030)	0.01390	0.00680	53.20°
3500K	Single 5-step MacAdam ellipse	(0.4073, 0.3917)	0.01545	0.00690	54.00°
4000K	Single 5-step MacAdam ellipse	(0.3818, 0.3797)	0.01565	0.00670	53.70°
5000K	Single 5-step MacAdam ellipse	(0.3447, 0.3553)	0.01370	0.00590	59.60°
5700K	Single 5-step MacAdam ellipse	(0.3287, 0.3417)	0.01243	0.00533	59.09°
6500K	Single 5-step MacAdam ellipse	(0.3123, 0.3282)	0.01115	0.00475	58.57°

**Notes for Table 7:**

1. 1-step and 3-step are available in 80CRI and 90CRI. 5-step is available in 70, 80 and 90CRI.
2. Lumileds maintains a tolerance of ±0.005 on x and y color coordinates in the CIE color space.

Table 8. MacAdam ellipse color bin definitions for LXZ2-xxxx and LXZH-xxx-x.

BIN	SDCM
10	1-step MacAdam ellipse (80, 90CRI)
30	3-step MacAdam ellipse (80, 90CRI)
3U	3-step MacAdam ellipse (80, 90CRI)
3L	3-step MacAdam ellipse (80, 90CRI)
50	5-step MacAdam ellipse (70CRI)
5A	5-step MacAdam ellipse (70, 80, 90CRI)
5B	5-step MacAdam ellipse (70, 80, 90CRI)
5C	5-step MacAdam ellipse (70, 80, 90CRI)
5D	5-step MacAdam ellipse (70, 80, 90CRI)

## Forward Voltage Bins

Table 9a. Forward voltage bin definitions for LXZ2-xxxx.

BIN	FORWARD VOLTAGE (V)	
	MINIMUM	MAXIMUM
P	2.50	2.75
R	2.75	3.00
S	3.00	3.25
X	2.65	2.85
Y	2.85	3.00

Notes for Table 9a:

1. Lumileds maintains a tolerance of  $\pm 0.06V$  on forward voltage measurements.

Table 9b. Forward voltage bin definitions for LXZH-xxxx-x.

BIN	FORWARD VOLTAGE (V)	
	MINIMUM	MAXIMUM
E	48.5	49.0
F	49.0	49.5
G	49.5	50.0
H	50.0	50.5

Notes for Table 9b:

1. Lumileds maintains a tolerance of  $\pm 0.06V$  on forward voltage measurements.

## Peak Wavelength Bins

Table 10. Peak wavelength bins for LXZ2-PR02.

BIN	PEAK WAVELENGTH (nm)	
	MINIMUM	MAXIMUM
3	440	445
4	445	450
5	450	455

Notes for Table 10:

1. Lumileds maintains a tolerance of  $\pm 2nm$  on peak wavelength measurements.

# Mechanical Dimensions

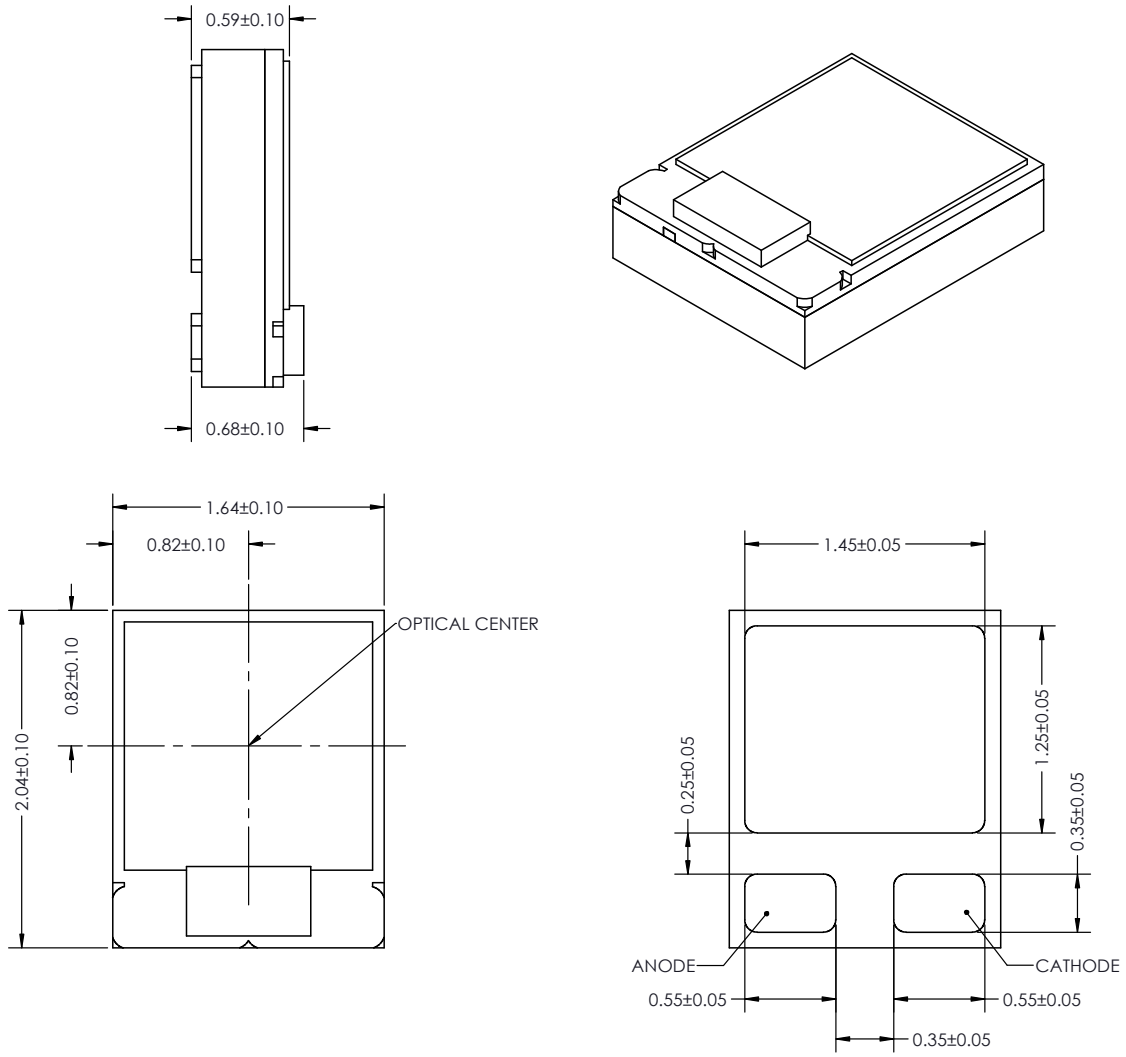


Figure 10: Mechanical dimensions for LUXEON Z ES.

**Notes for Figure 10:**

1. Drawings are not to scale.
2. All dimensions are in millimeters.

# Soldering Reflow Guidelines

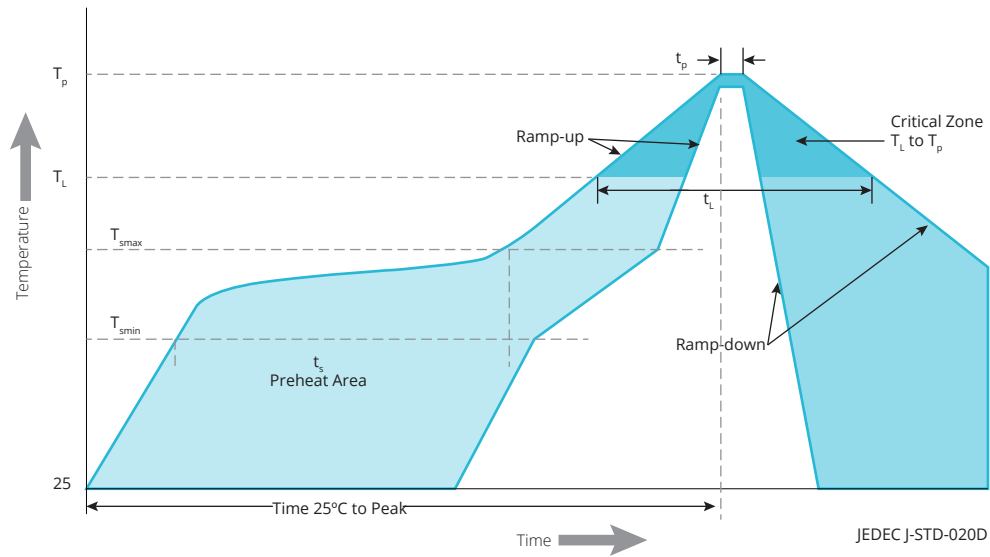


Figure 11: Temperature profile for Table 11.

Table 11. Reflow profile characteristics for LUXEON Z ES.

PROFILE FEATURE	LEAD FREE ASSEMBLY
Preheat Minimum Temperature ( $T_{smin}$ )	150°C
Preheat Maximum Temperature ( $T_{smax}$ )	200°C
Preheat Time ( $t_{smin}$ to $t_{smax}$ )	60 to 120 seconds
Ramp-Up Rate ( $T_{smax}$ to $T_p$ )	3°C / second maximum
Liquidus Temperature ( $T_L$ )	217°C
Time Maintained Above Temperature $T_L$ ( $t_t$ )	60 to 150 seconds
Peak / Classification Temperature ( $T_p$ )	260°C
Time Within 5°C of Actual Temperature ( $t_p$ )	20 to 40 seconds
Ramp-Down Rate	6°C / second maximum
Time 25°C to Peak Temperature	8 minutes maximum

## JEDEC Moisture Sensitivity

Table 12. Moisture sensitivity levels for LUXEON Z ES.

LEVEL	FLOOR LIFE		SOAK REQUIREMENTS STANDARD	
	TIME	CONDITIONS	TIME	CONDITIONS
1	Unlimited	≤30°C / 85% RH	168 Hours + 5 / - 0Hrs	85°C / 85% RH

# Solder Pad Design

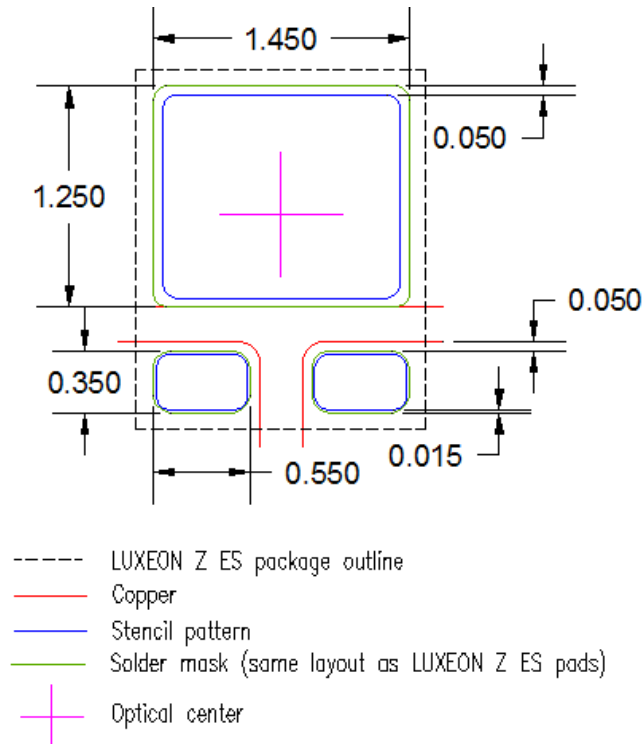


Figure 12: Solder pad layout for LUXEON Z ES.

## Notes for Figure 12:

1. All dimensions are in millimeters.
2. The figure shows one of the LUXEON Z ES layouts for close-packing design on Printed Circuit Board (PCB). For more information on assembly and additional layouts, please refer to LUXEON Z ES Application Brief (AB120).
3. The \*.dwg files are available at [lumileds.com](http://lumileds.com).

# Packaging Information

## Pocket Tape Dimensions

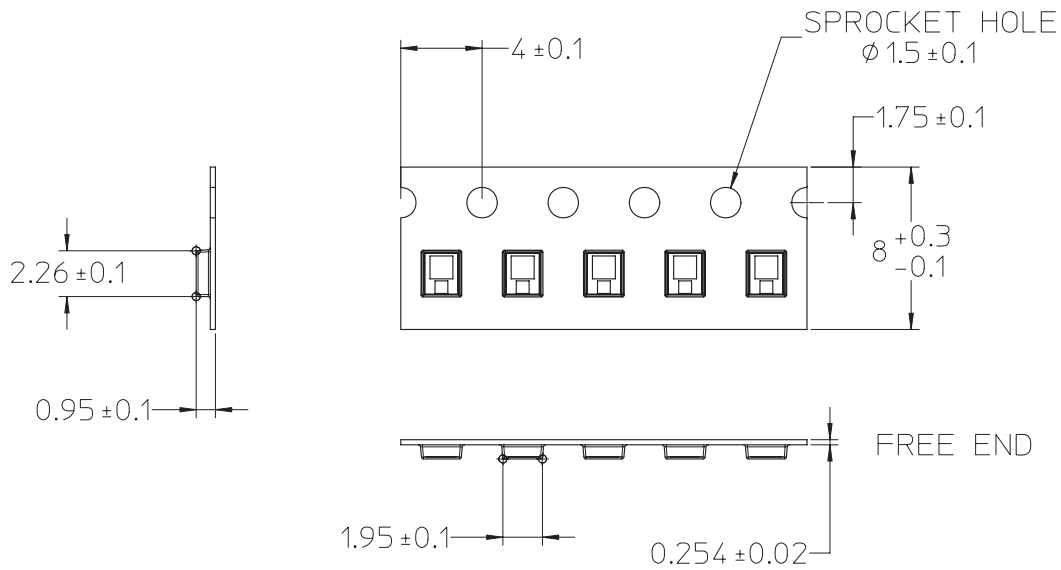


Figure 13: Tape dimensions for LUXEON Z ES.

### Notes for Figure 13:

1. Drawings are not to scale.
2. All dimensions are in millimeters.

## Reel Dimensions

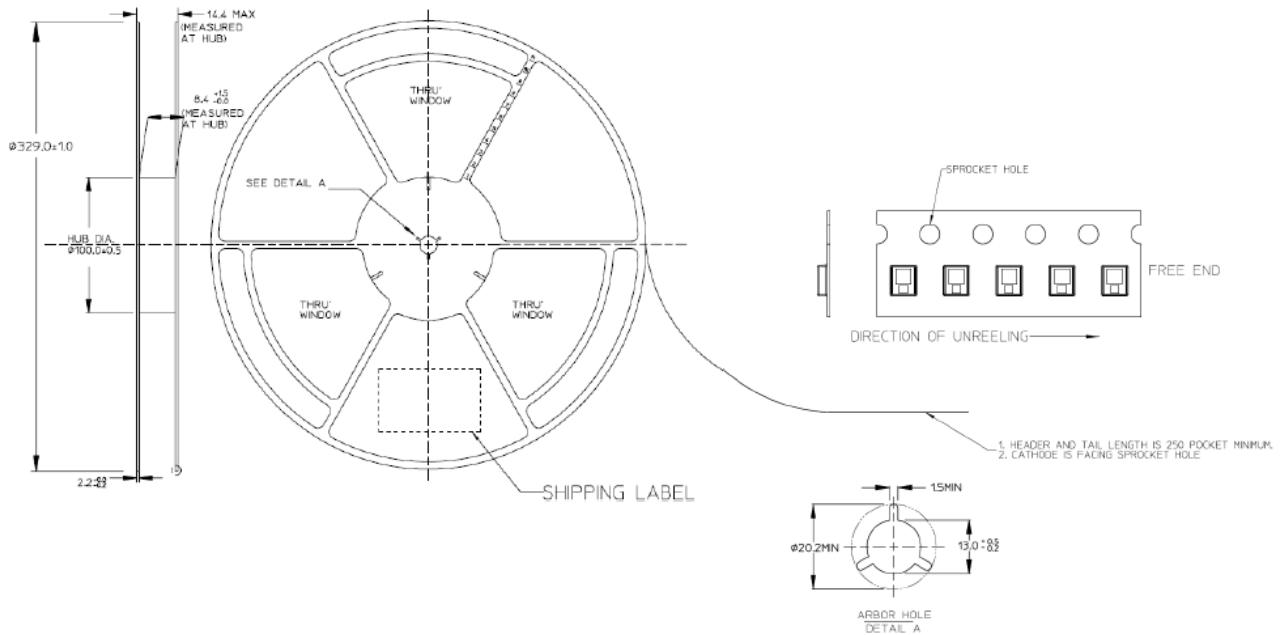


Figure 14: Reel dimensions for LUXEON Z ES.

### Notes for Figure 14:

1. Drawings are not to scale.
2. All dimensions are in millimeters.

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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.

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