

Color and White
LED Portfolio

*Illuminating
your creativity*

Technical Datasheet DS105

LUXEON[®]
NEVER BEFORE POSSIBLE



LUXEON[®] Z

Color and White LED Portfolio

Introduction

LUXEON[®] Z is a broad portfolio of Color and White LEDs that enable never before seen lumen density, flexibility and freedom of design. Available in the full spectrum of colors from 440nm to 670nm and select white color temperatures, LUXEON Z is ideal for entertainment/stage lighting, indoor and outdoor architectural lighting, emergency vehicle lighting, remote phosphor applications and a wide spectrum of specialty lighting applications.

Features

- 2.2 mm² micro footprint
- Un-encapsulated
- Tested and Binned at 500 mA
- Up to 1A max drive current
- Up to 150C max Tj

Benefits

- Industry's leading Lm/mm² for high flux density solution
- Highest degree of design flexibility
- Superior color mixing and beam control through choice of optics
- Enables customizable light sources: linear, rectangular, circular.

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General Product Information

Product Nomenclature

The part number designation for LUXEON Z - Color LEDs is explained as follows:

L X Z I - A B C D - E F G H

Where:

- A — designates radiation pattern (value P for lambertian)
- B — designates color (see LUXEON Z color binning and labeling section)
- C — designates color variant (0 for color variants)
- D — designates test current (value I for 500 mA.)
- E — open slot to accommodate additional requirements per product and part number
- FGH — minimum luminous flux (lm) or radiometric power (mW) performance

The part number designation for LUXEON Z - White LEDs is explained as follows

L X Z I - A B C D - E F G H

Where:

- AB — two digits representing nominal CCT (e.g. 30 = 3000K, 40 = 4000K)
- CD — two digits representing minimum CRI (e.g. 70 for 70 CRI, 80 for 80 CRI)
- E — open slot to accommodate additional requirements per product and part number
- FGH — minimum luminous flux (lm)

Flux and Efficacy Performance Characteristics

Luminous Flux Characteristics for LUXEON Z Color Portfolio, Thermal Pad Temperature =25°C

Table I.

Color	Part Number	Min Luminous Flux (lm) or Radiometric Power (mW)	Typ Flux (lm/mw)	Typ Efficacy (lm/W) or WPE	Performance @ 500 mA		Performance @ 700 mA	
					Typ Luminous Flux (lm) or Radiometric Power (mW)	Typ Efficacy (lm/W) or WPE	Typ Luminous Flux (lm) or Radiometric Power (mW)	Typ Efficacy (lm/W) or WPE
Green	LXZ1-PM01-0104	104	106	71	128	61	120	53
	LXZ1-PM01-0096	96	98	63	113	50	103	46
	LXZ1-PM01-0088	88	92	59	49	35		
	LXZ1-PM01-0080	80	84	54				
	LXZ1-PM01-0072	72	76	3.10				
Cyan	LXZ1-PE01-0072	72	73	48	86	41	84	38
	LXZ1-PE01-0064	64	68	44	74	33	67	30
	LXZ1-PE01-0056	56	60	39				
	LXZ1-PE01-0048	48	54	35				
Blue	LXZ1-PB01-0048	48	50	34	65	30	57	27
	LXZ1-PB01-0040	40	44	30	49	23	39	19
	LXZ1-PB01-0032	32	38	26				
	LXZ1-PB01-0024	24	30	21				
Royal Blue	LXZ1-PR01-0600	600	620	43%	823	40%	757	37%
	LXZ1-PR01-0550	550	570	40%	704	35%		
	LXZ1-PR01-0500	500	530	37%				
Deep Red	LXZ1-PA01-0350	350	360	34%	454	31%	416	29%
	LXZ1-PA01-0300	300	330	32%	353	24%		
	LXZ1-PA01-0250	250	280	26%				
Red	LXZ1-PD01-0056	56	57	54	77	49	70	46
	LXZ1-PD01-0048	48	52	50	60	38		
	LXZ1-PD01-0040	40	44	42				
Red-Orange	LXZ1-PH01-0072	72	74	69	99	66	90	58
	LXZ1-PH01-0064	64	66	63	82	53		
	LXZ1-PH01-0056	56	60	57				
Amber	LXZ1-PL01-0064	64	66	63	90	59	82	53
	LXZ1-PL01-0056	56	60	57	73	48		
	LXZ1-PL01-0048	48	54	51				

Notes for Table I:

1. Minimum luminous flux or radiometric power performance guaranteed within published operating conditions. Philips Lumileds maintains a tolerance of $\pm 6.5\%$ on flux and power measurements.
2. Typical luminous flux or radiometric power performance when device is operated within published operating conditions.

Flux and Efficacy Performance Characteristics, Continued

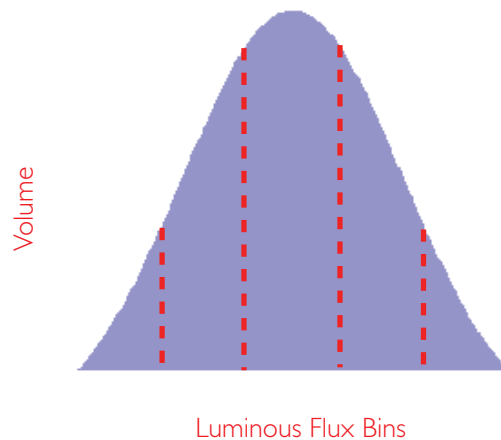
Luminous Flux Characteristics for LUXEON Z White, Thermal Pad Temperature =25°C

Table 2.

White	Part Number	Min Luminous Flux (lm)	Typ Flux (lm/mw)	Typ Efficacy (lm/W)	Typ Luminous Flux (lm)	Typ Efficacy (lm/W)
					Performance @ 700 mA	
Performance @ 500 mA					Performance @ 700 mA	
4000K/ 70 CRI	LXZ1-4070-0144	144	148	102	194	94
	LXZ1-4070-0134	134	140	96	183	88
	LXZ1-4070-0124	124	130	90	170	83

Flux Performance, Binning, and Supportability

LEDs are produced with semiconductor technology that is subject to process variation, yielding a range of flux performance that is approximately Gaussian in nature. In order to provide customers with fine granularity within the overall flux distribution, Philips Lumileds separates LEDs into fixed, easy to design with, minimum luminous flux bins. To verify supportability of parts chosen for your application design, please consult your Philips Lumileds sales representative.



Optical Characteristics

LUXEON Z Color Portfolio at Test Current = 500 mA Thermal Pad Temperature = 25°C

Table 3.

Color	Dominant Wavelength ^[1] λ_D , or Peak Wavelength ^[2] λ_p			Typical Spectral Half-width ^[3] (nm) $\Delta\lambda_{1/2}$	Typical Temperature Coefficient of Dominant or Peak Wavelength (nm/°C) $\Delta\lambda_D / \Delta T_J$	Typical Total Included Angle ^[4] (degrees) $\theta_{0.90V}$	Typical Viewing Angle ^[5] (degrees) $2\theta_{1/2}$
	Min.	Typ.	Max.				
Green ^[6]	520.0 nm	530.0 nm	540.0 nm	30	0.04	140	125
Cyan ^[6]	490.0 nm	505.0 nm	508.0 nm	30	0.03	140	125
Blue ^[6]	460.0 nm	470.0 nm	480.0 nm	20	0.03	140	125
Royal Blue ^{[2] [6]}	440.0 nm	447.5 nm	460.0 nm	20	0.03	140	125
Red ^[7]	620.0 nm	627.0 nm	645.0 nm	20	0.06	150	145
Deep Red ^[7]	650.0 nm	655.0 nm	670.0 nm	20	0.06	150	145
Red-Orange ^[7]	610.0 nm	617.0 nm	620.0 nm	20	0.06	150	145
Amber ^[7]	584.5 nm	590.0 nm	597.0 nm	20	0.10	150	145

Notes for Table 3:

1. Dominant wavelength is derived from the CIE 1931 Chromaticity diagram and represents the perceived color. Philips Lumileds maintains a tolerance of ± 0.5 nm for dominant wavelength measurements.
2. Royal Blue and Deep Red LEDs are binned by radiometric power and peak wavelength rather than photometric lumens. Philips Lumileds maintains a tolerance of ± 2 nm for peak wavelength measurements.
3. Spectral width at $1/2$ of the peak intensity.
4. Total angle at which 90% of total luminous flux is captured.
5. Viewing angle is the off axis angle from lamp centerline where the luminous intensity is $1/2$ of the peak value.
6. Green, cyan, blue, royal blue and white products are built with Indium Gallium Nitride (InGaN).
7. All red, deep red, red-orange, and amber are built with Aluminum Indium Gallium Phosphide (AlInGaP).

LUXEON Z White at Test Current = 500 mA Thermal Pad Temperature = 25°C

Table 4.

Nominal ANSI CCT	Part Number	Typical Total Included Angle ^[1] (degrees) $\theta_{0.90V}$	Typical Viewing Angle ^[2] (degrees) $2\theta_{1/2}$
4000K	LXZ1-4070-XXXX	140	120

Notes for Table 4:

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

Electrical Characteristics

Electrical Characteristics at 500 mA for LUXEON Z Colors, Thermal Pad Temperature = 25°C

Table 5.

Color	Part Number	Forward Voltage V_f @ 500 mA (V)			Forward Voltage V_f @ 700 mA	Typical Temperature Coefficient of Forward Voltage ^[1] (mV/°C)	Typical Thermal Resistance Junction to Thermal Pad (°C/W)
		Min.	Typ.	Max.	Typ.	$\Delta V_f / \Delta T_j$	$R\theta_{j-c}$
Green	LXZI-PM01	2.50	3.05	3.50	3.15	-2 to -4	5
Cyan	LXZI-PE01	2.50	2.95	3.50	3.05	-2 to -4	5
Blue	LXZI-PB01	2.50	3.15	3.50	3.25	-2 to -4	5
Royal Blue	LXML-PR01	2.50	2.90	3.50	2.95	-2 to -4	5
Red	LXZI-PD01	1.75	2.20	2.75	2.40	-2 to -4	8
Deep Red	LXZI-PA01	1.75	2.25	2.75	2.40	-2 to -4	8
Red-Orange	LXZI-PH01	1.75	2.15	2.75	2.25	-2 to -4	8
Amber	LXZI-PL01	1.75	2.15	2.75	2.25	-2 to -4	8

Notes for Table 5:

1. Measured between 25°C = T_j = 85°C at I_f = 500 mA.
2. Philips Lumileds maintains a tolerance of $\pm 0.06V$ on forward voltage measurements.

Electrical Characteristics at 500 mA for LUXEON Z White, Thermal Pad Temperature = 25°C

Table 6.

White	Part Number	Forward Voltage V_f ^[1] @ 500 mA (V)			Forward Voltage V_f @ 700 mA	Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C)	Typical Thermal Resistance Junction to Thermal Pad (°C/W)
		Min.	Typ.	Max.	Typ.	$\Delta V_f / \Delta T_j$	$R\theta_{j-c}$
4000K/70CRI	LXZI-4070	2.50	2.90	3.50	2.95	-2 to -4	6

Absolute Maximum Ratings

Table 7.

Parameter	Green/Cyan/ Blue/Royal Blue	Red/Deep-Red Red-Orange/Amber	White 4000K
DC Forward Current (mA)	1000	700	700
Peak Pulsed Forward Current (mA)	1000	700	700
ESD Sensitivity	JESD22-A114-B		
LED Junction Temperature ^[1]	150°C	135°C	130°C
Operating Case Temperature at 500 mA	-40°C - 135°C	-40°C - 120°C	-40°C - 110°C
Storage Temperature	-40°C - 135°C	-40°C - 135°C	-40°C - 135°C
Soldering Temperature	JEDEC 020c 260°C	JEDEC 020c 260°C	JEDEC 020c 260°C
Allowable Reflow Cycles	3	3	3
Reverse Voltage (Vr)	Autoclave Conditions 121°C at 2 ATM 100% Relative Humidity for 96 Hours Maximum LUXEON Rebel Color Portfolio LEDs are not designed to be driven in reverse bias.		

Notes for Table 7:

1. Proper current derating must be observed to maintain junction temperature below the maximum.

JEDEC Moisture Sensitivity

Table 8.

Level	Floor Life		Soak Requirements	
	Time	Conditions	Standard	
			Time (hours)	Conditions
I	unlimited	≤ 30°C / 85% RH	168 + 5 / -0	85°C / 85% RH

Reflow Soldering Characteristics



Table 9.

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 (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

Note for Table 9:

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

Mechanical Dimensions: LUXEON Z Blue/Green/Royal Blue and Cyan Emitters

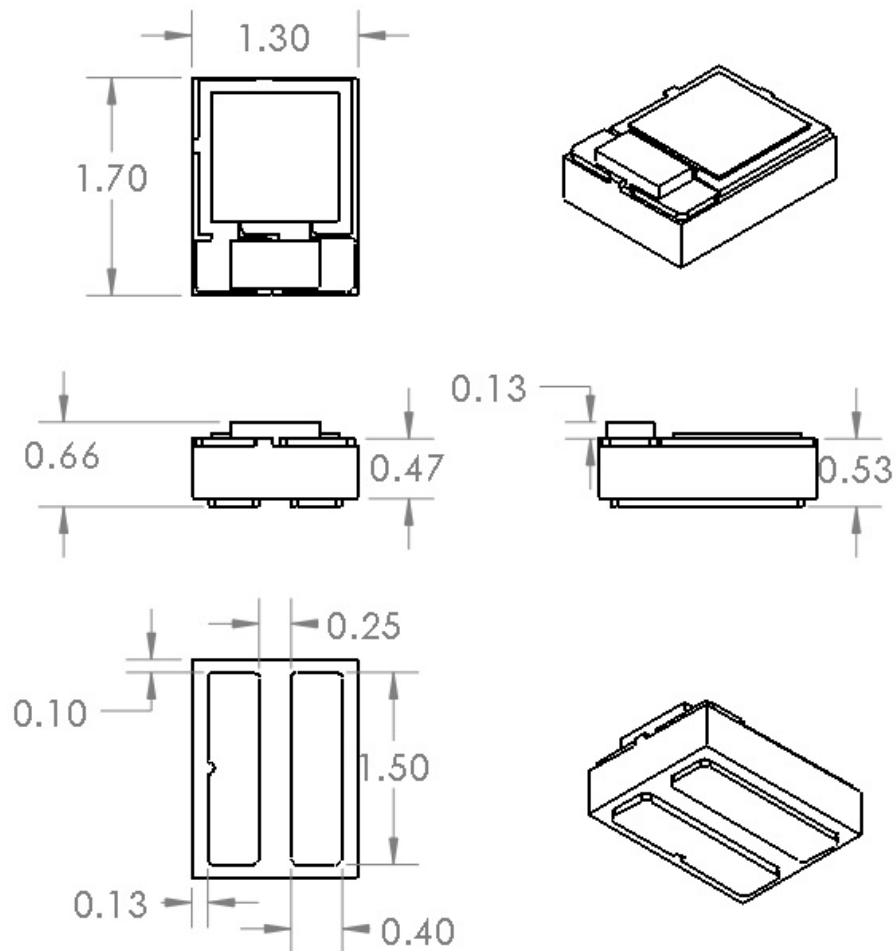


Figure 1. Package outline drawing.

Notes for Figure 1:

- To avoid damage, do not manually exert any force to the top surface. See AB105 for handling precaution.
- Drawings not to scale.
- All dimensions are in millimeters.

Mechanical Dimensions: LUXEON Z White Emitter

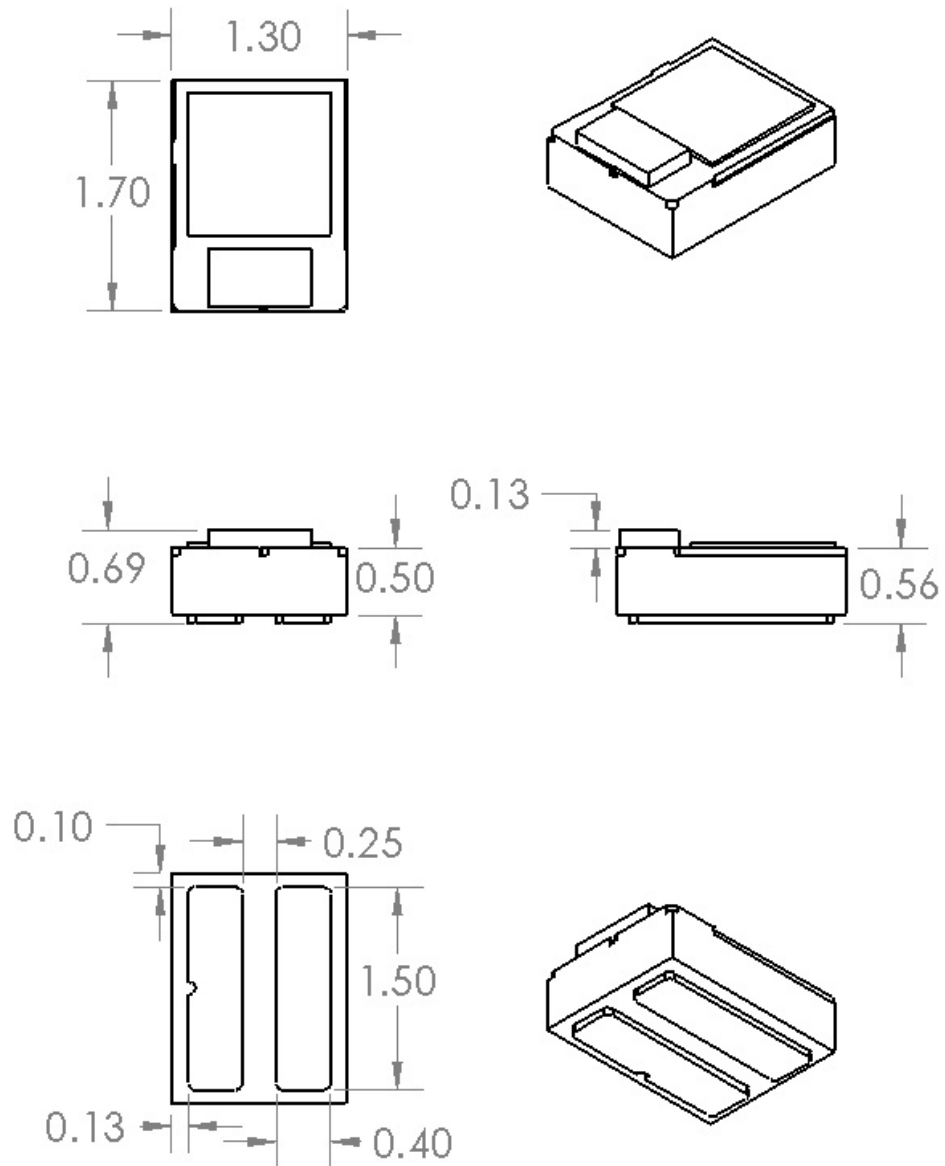


Figure 2. Package outline drawing.

Notes for Figure 2:

- To avoid damage, do not manually exert any force to the top surface. See AB105 for handling precaution.
- Drawings not to scale.
- All dimensions are in millimeters.

Mechanical Dimensions: LUXEON Z Red, Red-Orange, Amber and Deep Red Emitters

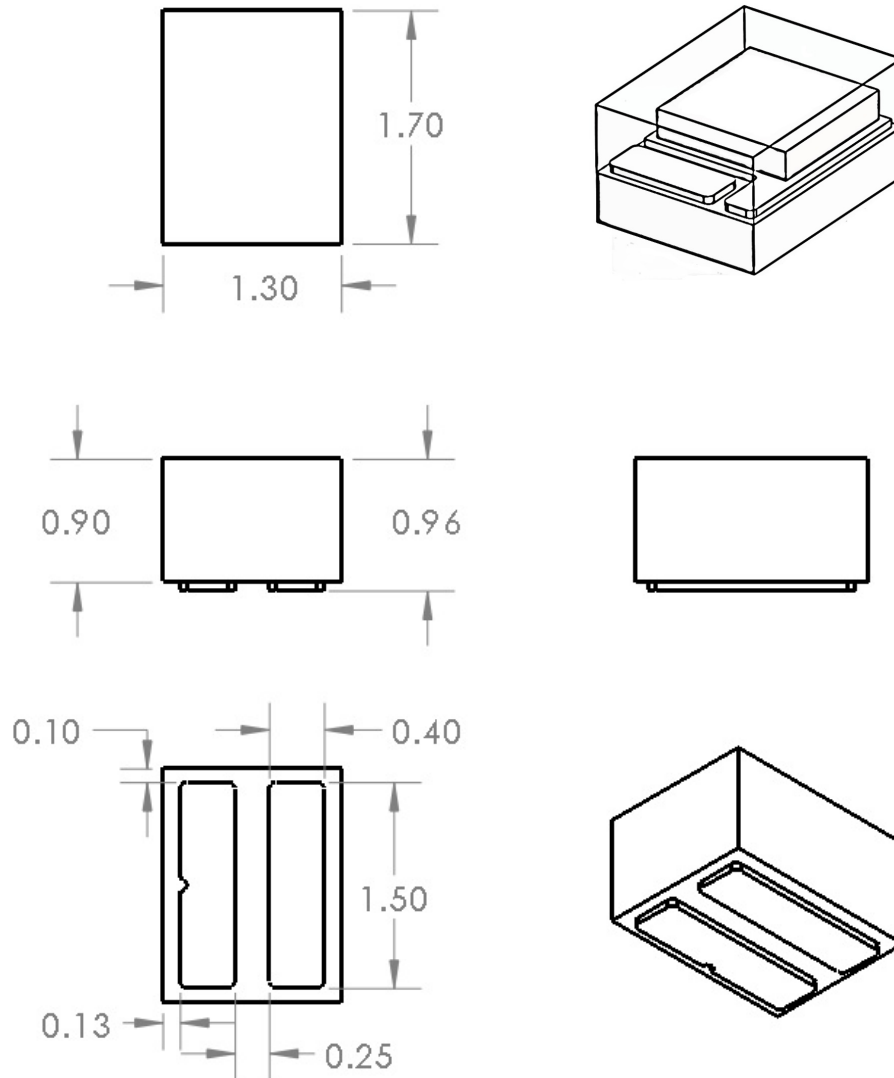


Figure 3. Package outline drawing.

Notes for Figure 3:

- To avoid damage, do not manually exert any force to the top surface or handle from the sides of the silicone layer. See AB105 for handling precaution.
- Drawings not to scale.
- All dimensions are in millimeters.

Pad Configuration

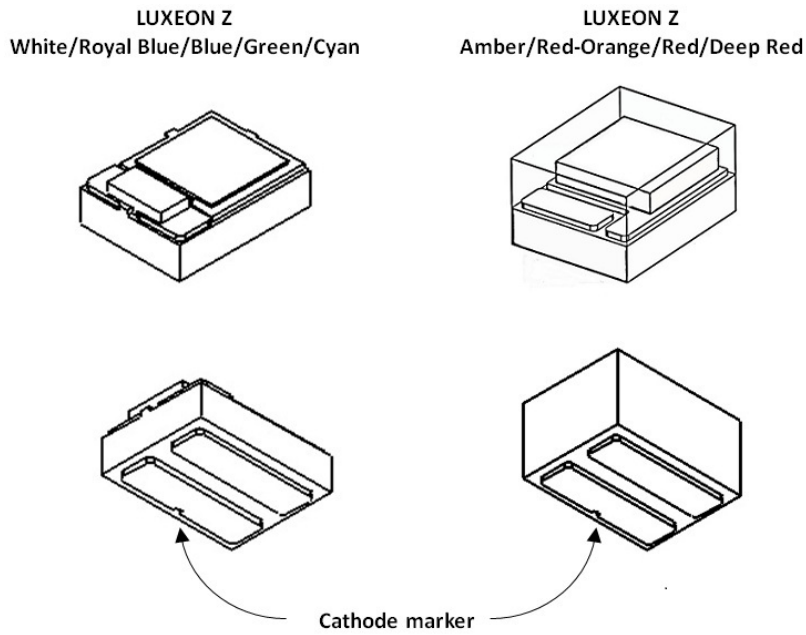


Figure 4. Pad configuration.

Solder Pad Design

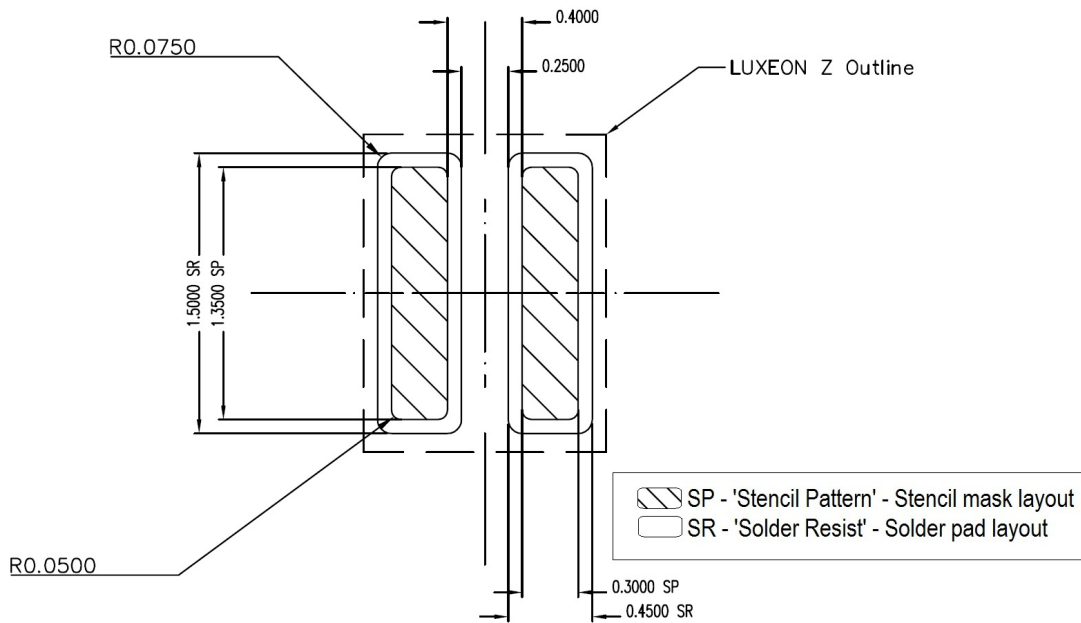


Figure 5. Solder pad layout.

Wavelength Characteristics

Green, Cyan, Blue, all Royal Blue, Red, Red-Orange and Amber
at Test Current, Thermal Pad Temperature = 25°C

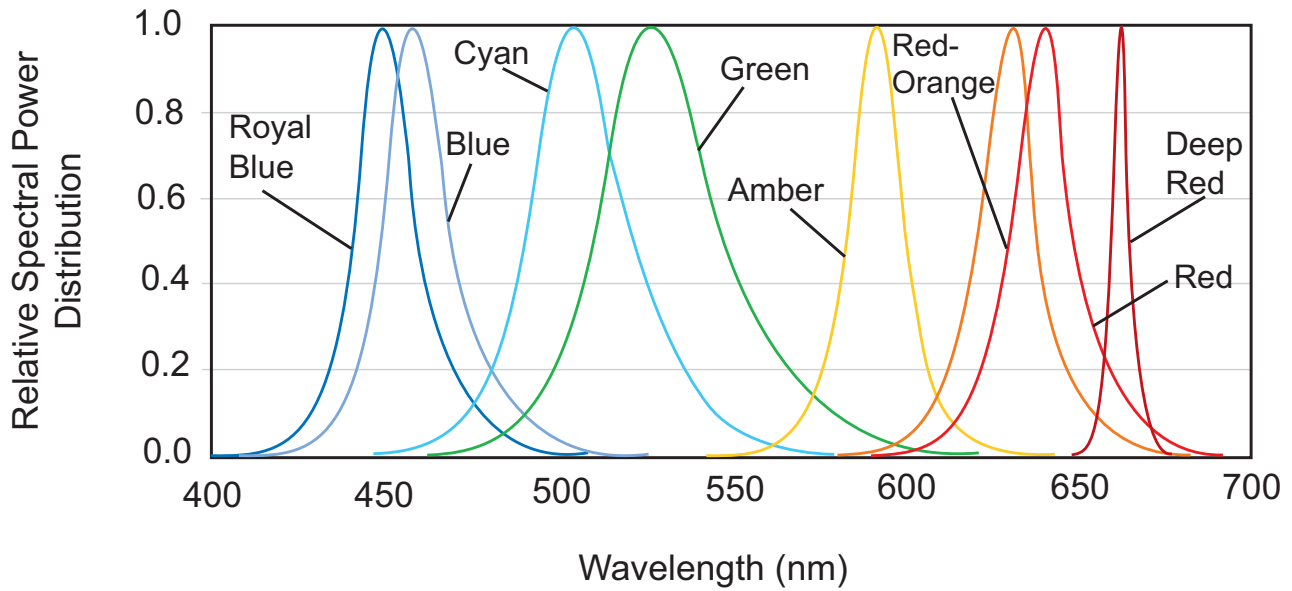


Figure 6. Relative intensity vs. wavelength.

Typical Light Output Characteristics over Temperature

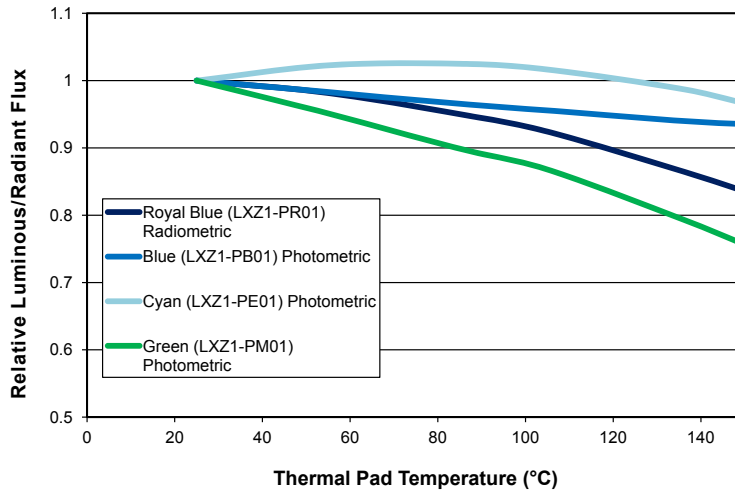


Figure 7. Relative light output vs. thermal pad temperature for cyan, blue, green and royal blue LUXEON Z at Test Current = 500 mA.

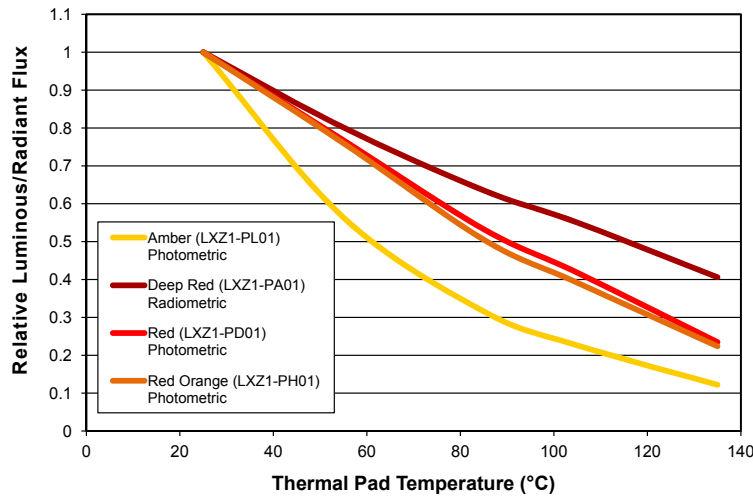


Figure 8. Relative light output vs. thermal pad temperature for red, deep red, red-orange and amber LUXEON Z at Test Current = 500 mA.

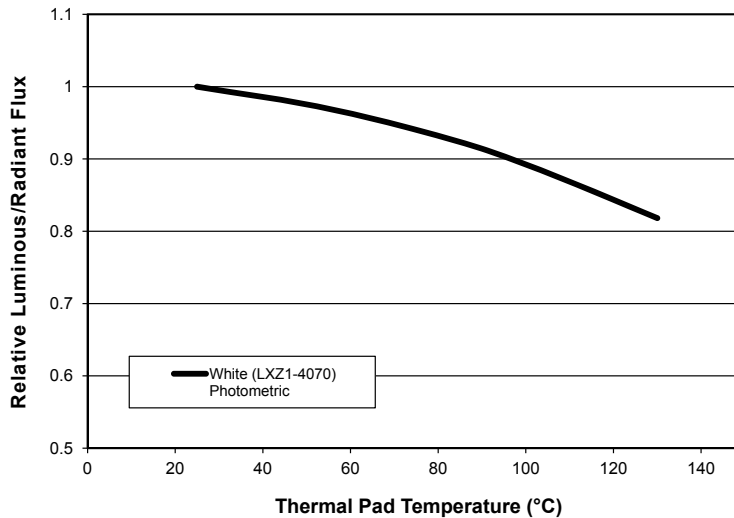


Figure 9. Relative light output vs. thermal pad temperature for white LUXEON Z at Test Current = 500 mA.

Typical Forward Current Characteristics

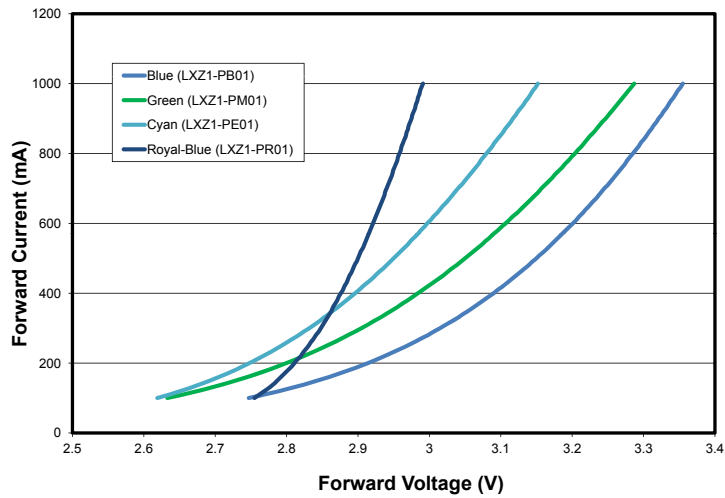


Figure 10. Forward current vs. forward voltage for green, cyan, blue and royal blue LUXEON Z at Thermal Pad Temperature = 25°C.

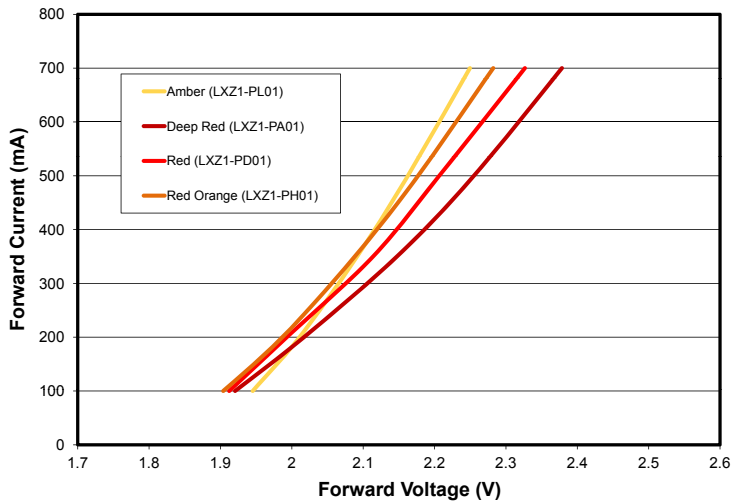


Figure 11. Forward current vs. forward voltage for red, deep red, red-orange and amber LUXEON Z at Thermal Pad Temperature = 25°C.

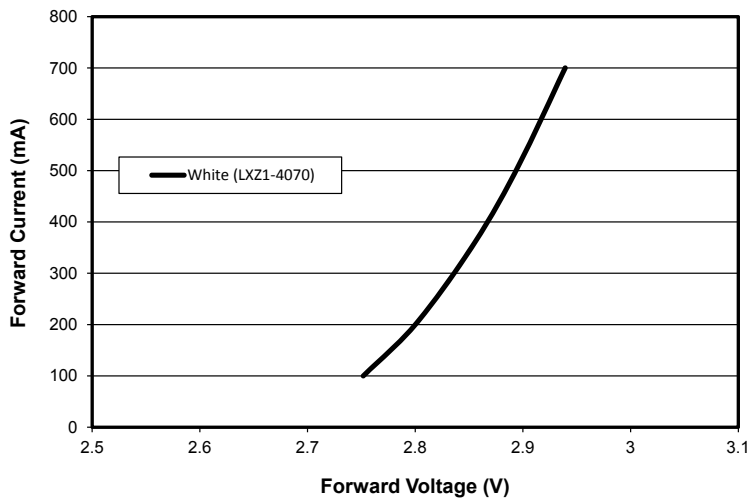


Figure 12. Forward current vs. forward voltage for white LUXEON Z at Thermal Pad Temperature = 25°C.

Typical Relative Luminous Flux

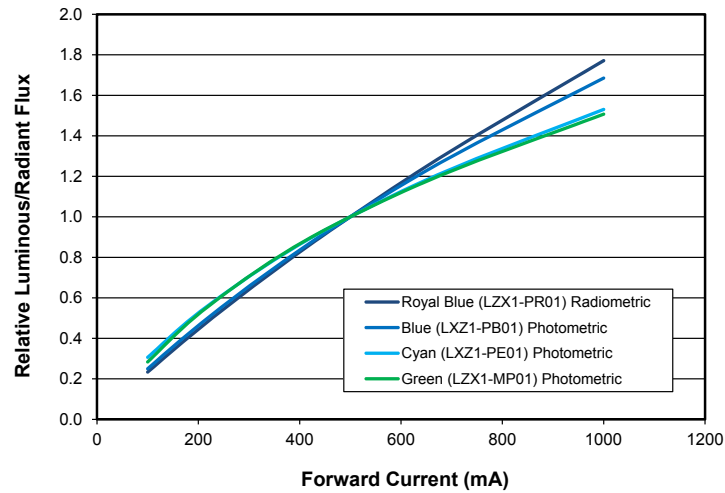


Figure 13. Typical relative luminous flux vs. forward current for green, cyan, blue & royal blue LUXEON Z at thermal pad temperature = 25°C.

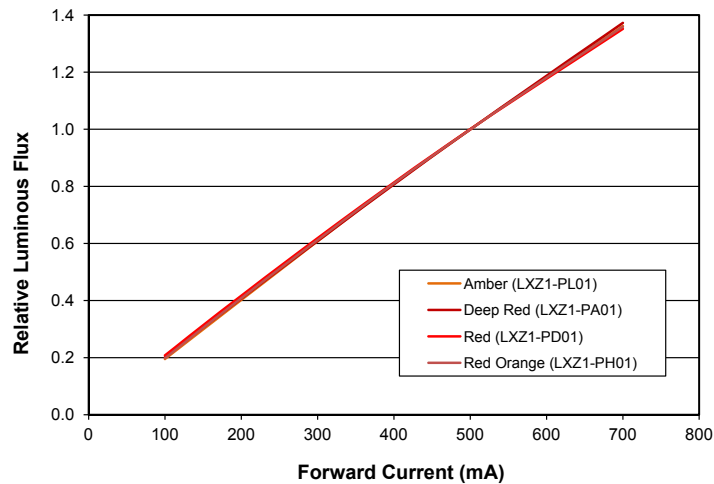


Figure 14. Typical relative luminous flux vs. forward current for red, deep red, red-orange & amber LUXEON Z at thermal pad temperature = 25°C.

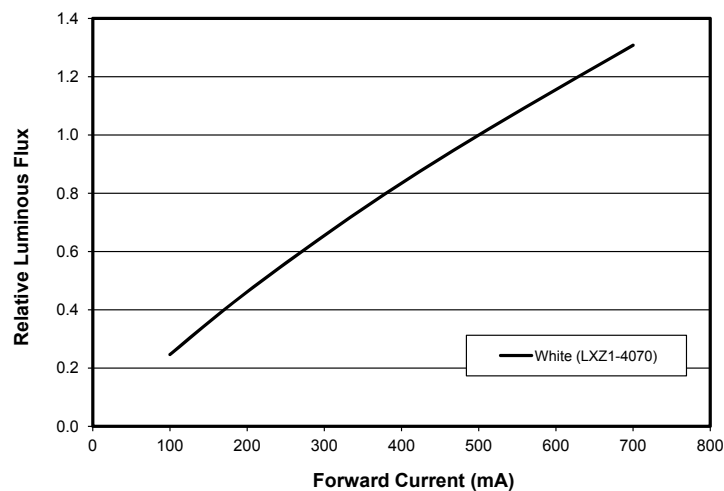


Figure 15. Typical relative luminous flux vs. forward current for white LUXEON Z at thermal pad temperature = 25°C.

Typical Radiation Patterns

LUXEON Z Typical Spatial Radiation Pattern for Green, Cyan, Blue and Royal Blue

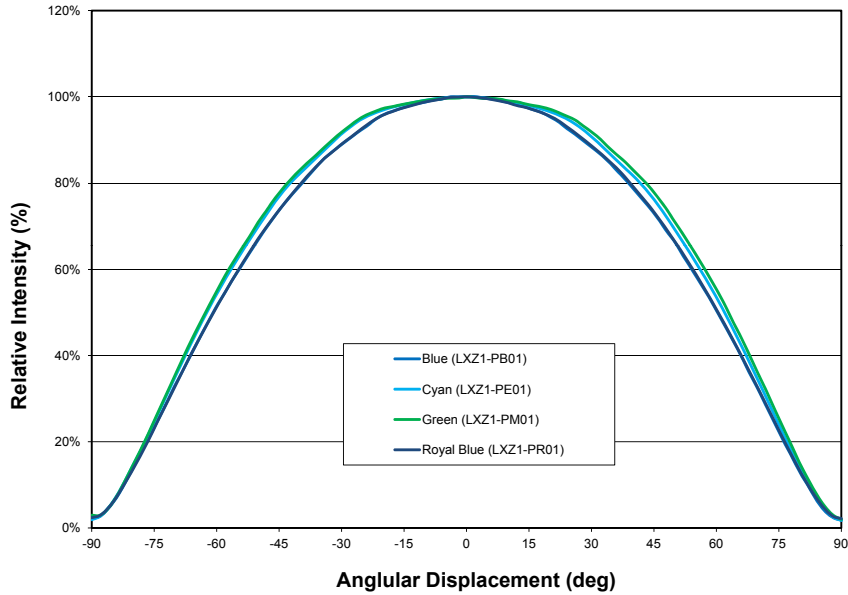


Figure 16. Typical spatial radiation pattern for green, cyan, blue and royal blue LUXEON Z.

LUXEON Z Typical Polar Radiation Pattern for Green, Cyan, Blue and Royal Blue

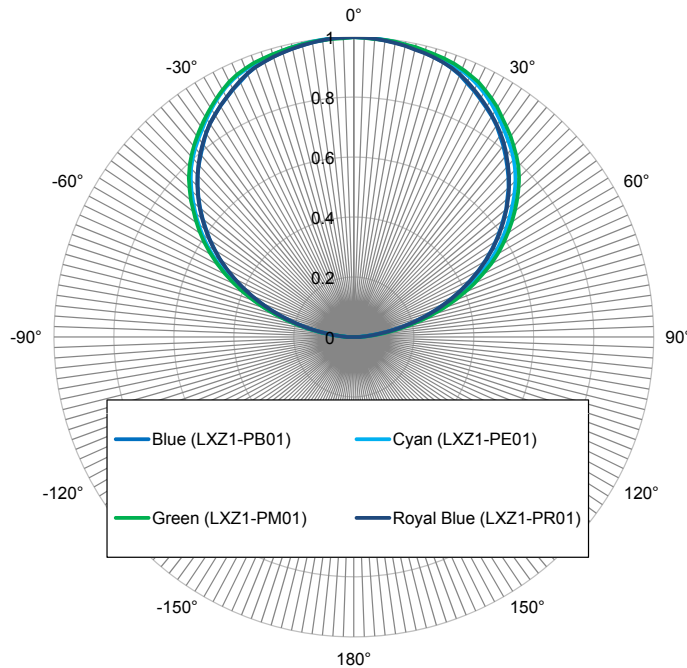


Figure 17. Typical polar radiation pattern for green, cyan, blue and royal blue LUXEON Z.

LUXEON Z Typical Spatial Radiation Pattern for Red, Red-Orange and Deep Red

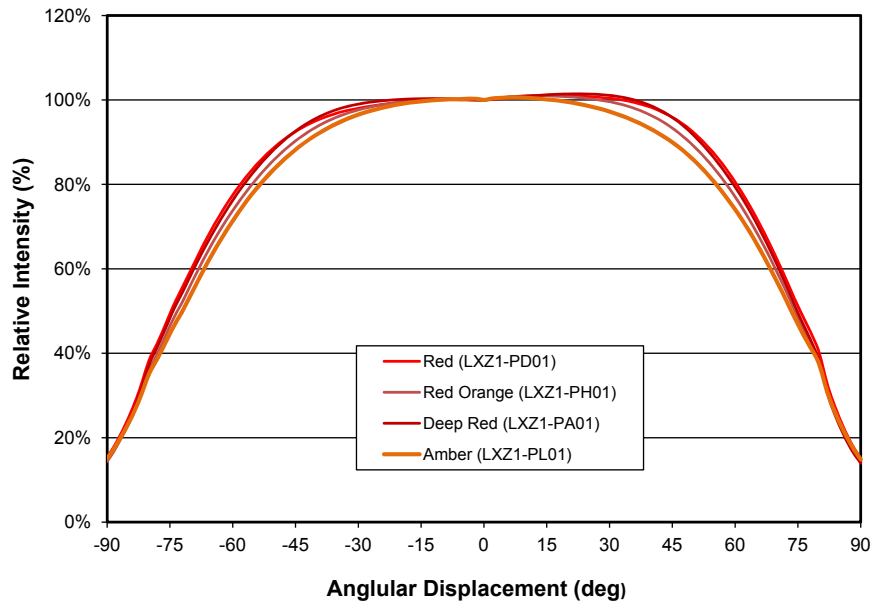


Figure 18. Typical spatial radiation pattern for red, red-orange and deep red.

LUXEON Z Typical Polar Radiation Pattern for Red, Red-Orange and Deep Red

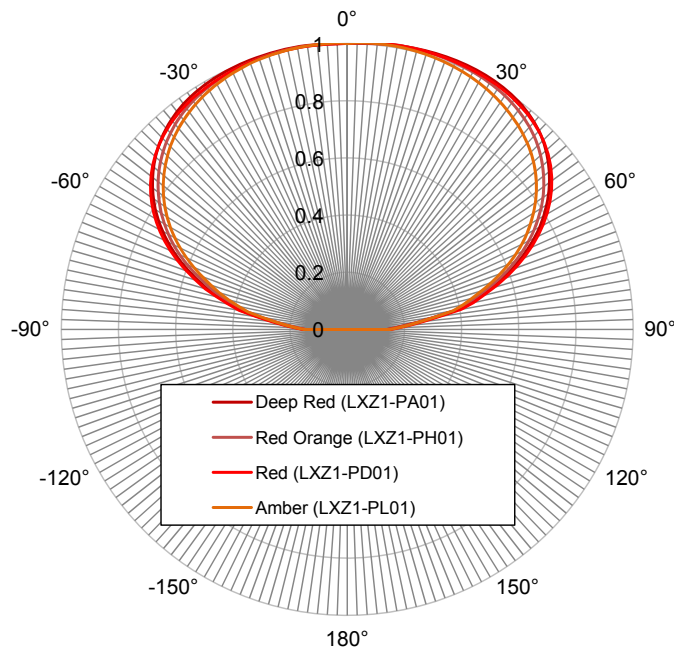


Figure 19. Typical polar radiation pattern for red, red-orange and deep red.

LUXEON Z Typical Spatial Radiation Pattern for White

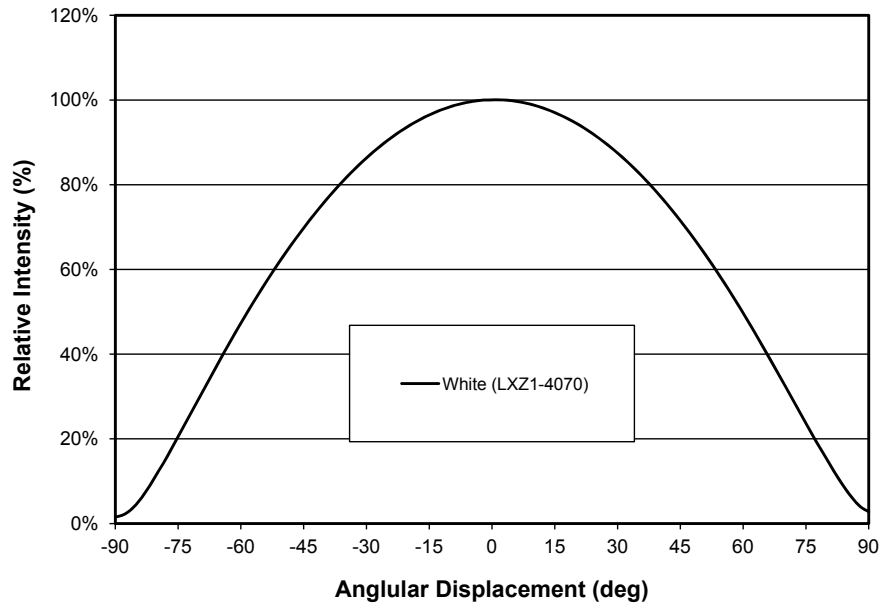


Figure 20. Typical spatial radiation pattern for white lambertian.

LUXEON Z Typical Polar Radiation Pattern for White

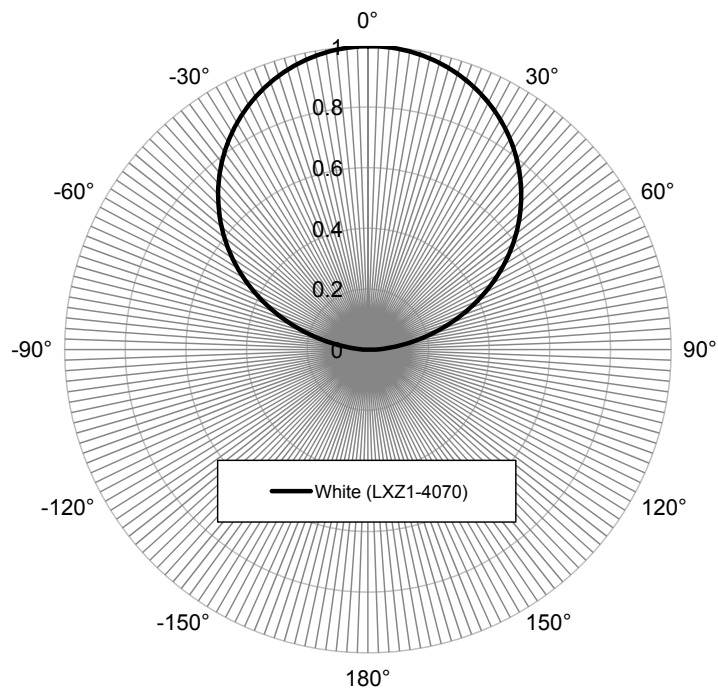


Figure 21. Typical polar radiation pattern for white lambertian.

Emitter Pocket Tape Packaging

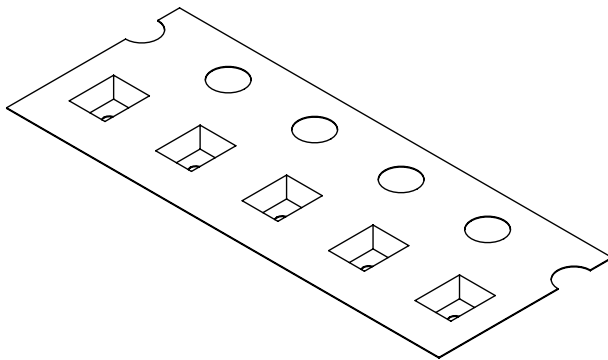
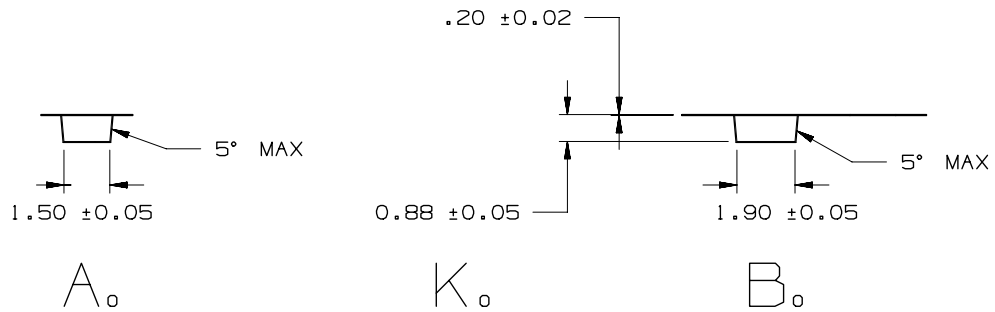
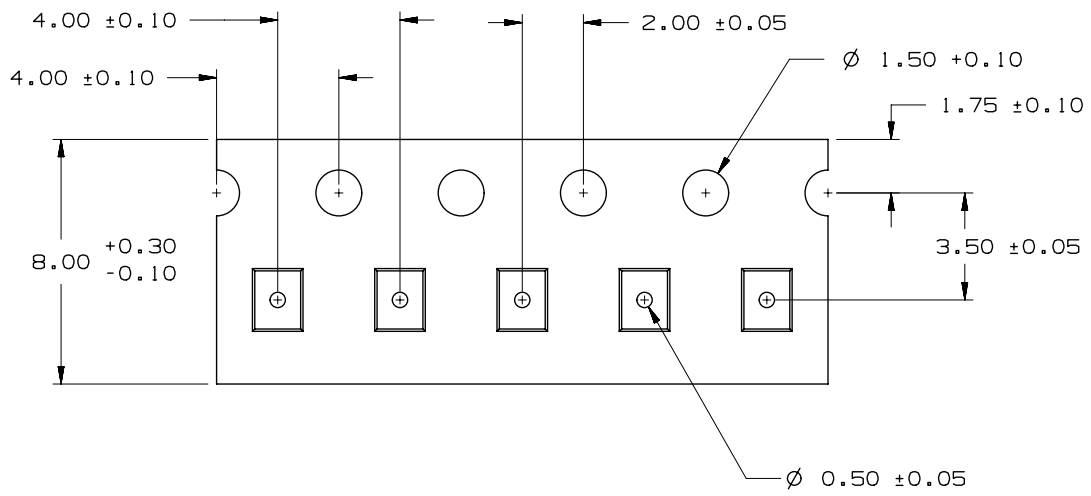


Figure 22. Emitter pocket tape packaging for Blue, Green, Royal Blue, Cyan and White.

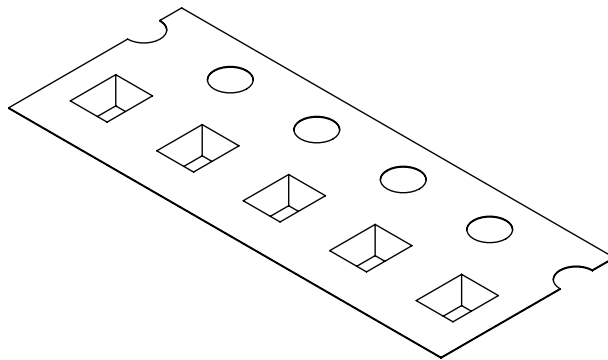
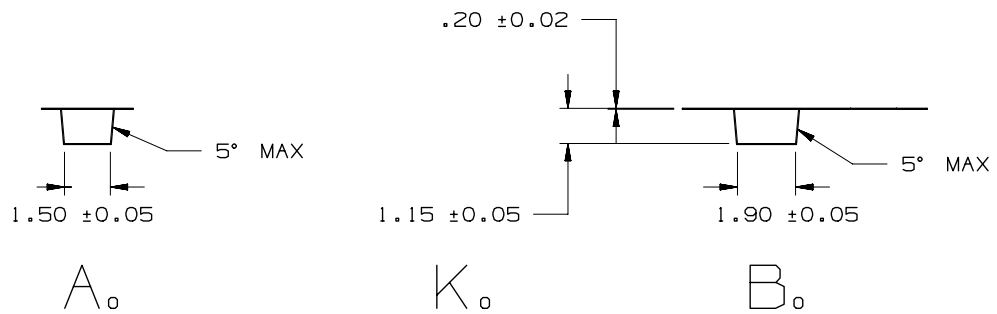
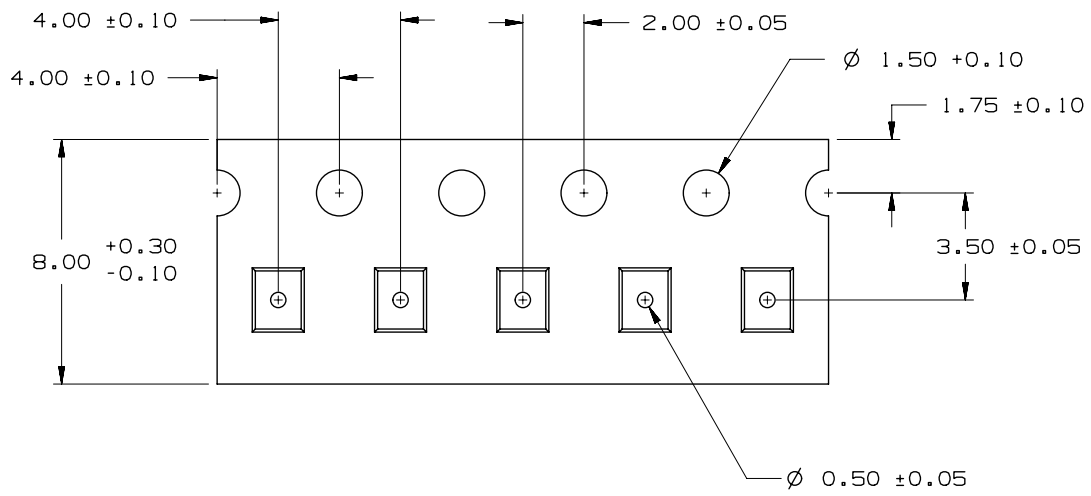


Figure 23. Emitter pocket tape packaging for Red, Red-Orange, Amber and Deep Red.

Emitter Reel Packaging

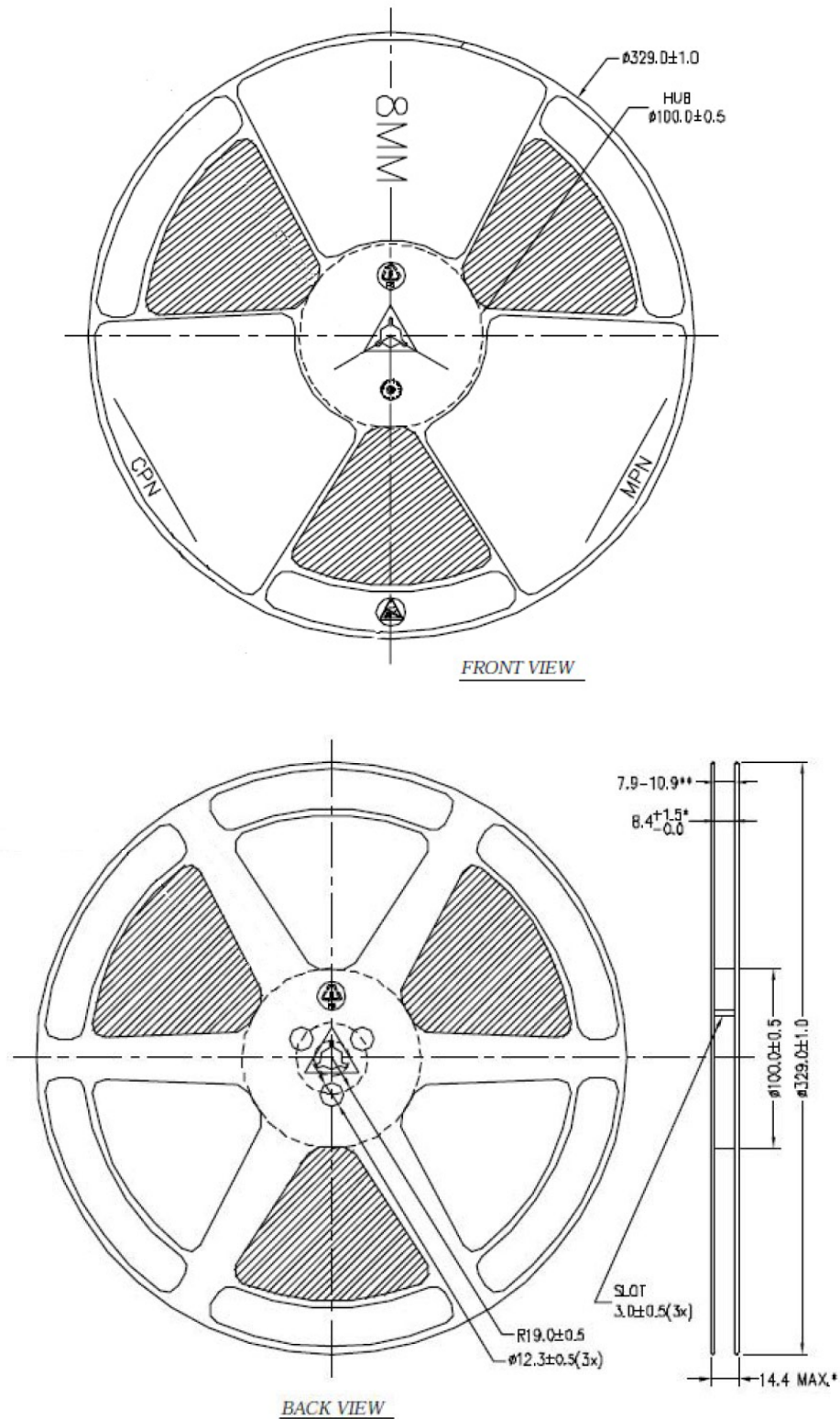


Figure 24. Emitter reel packaging.

Luminous Flux Bins

Tables 10 and 11 list the standard photometric luminous flux/radiometric power bins for LUXEON Z colors and LUXEON Z white emitters (tested and binned at 500 mA). 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 10.

LUXEON Z Flux Bins - All Colors and White		
Bin Code	Minimum Flux (lm)	Maximum Flux (lm)
A	24	32
B	32	40
C	40	48
D	48	56
E	56	64
F	64	72
G	72	80
H	80	88
J	88	96
K	96	104
L	104	114
M	114	124
N	124	134
P	134	144
Q	144	154
R	154	164

Table 11.

LUXEON Z Radiometric Power Bins for Royal Blue and Deep Red		
Bin Code	Minimum Radiometric Flux (mW)	Maximum Radiometric Flux (mW)
A	250	300
B	300	350
C	350	400
D	400	450
E	450	500
F	500	550
G	550	600
H	600	650
I	650	700

Forward Voltage Bins

The following forward voltage bins include the minimum and maximum V_f bin values for the emitter. Although several bins are outlined, product availability in a particular bin varies by production run and by product performance.

Table 12. Voltage Bins

V_f Bins		
Bin Code	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
1	1.75	2.00
2	2.00	2.25
3	2.25	2.50
4	2.50	2.75
5	2.75	3.00
6	3.00	3.25
7	3.25	3.50

Color Bins

Dominant Wavelength Bin Structure for LUXEON Z Green

Table 13.

Bin Code	Minimum Dominant Wavelength (nm)	Maximum Dominant Wavelength (nm)
1	520	525
2	525	530
3	530	535
4	535	540

Dominant Wavelength Bin Structure for LUXEON Z Cyan

Table 14.

Bin Code	Minimum Dominant Wavelength (nm)	Maximum Dominant Wavelength (nm)
1	490	498
2	498	508

Dominant Wavelength Bin Structure for LUXEON Z Blue

Table 15.

Bin Code	Minimum Dominant Wavelength (nm)	Maximum Dominant Wavelength (nm)
1	460	465
2	465	470
3	470	475
4	475	480

Peak Wavelength Bin Structure for LUXEON Z Royal Blue

Table 16.

Bin Code	Minimum Peak Wavelength (nm)	Maximum Peak Wavelength (nm)
3	440	445
4	445	450
5	450	455
6	455	460

Dominant Wavelength Bin Structure for LUXEON Z Red

Table 17.

Bin Code	Minimum Dominant Wavelength (nm)	Maximum Dominant Wavelength (nm)
4	620	630
5	630	640

Dominant Wavelength Bin Structure for LUXEON Z Red-Orange

Table 18.

Bin Code	Minimum Dominant Wavelength (nm)	Maximum Dominant Wavelength (nm)
2	610	620

Dominant Wavelength Bin Structure for LUXEON Z Amber

Table 19.

Bin Code	Minimum Dominant Wavelength (nm)	Maximum Dominant Wavelength (nm)
1	585	587
2	587	590
4	590	592
6	592	595

Peak Wavelength Bin Structure for LUXEON Z Deep Red

Table 20.

Bin Code	Minimum Dominant Wavelength (nm)	Maximum Dominant Wavelength (nm)
6	650	660
7	660	670

5-step MacAdam Ellipse Color Definition for LUXEON Z White

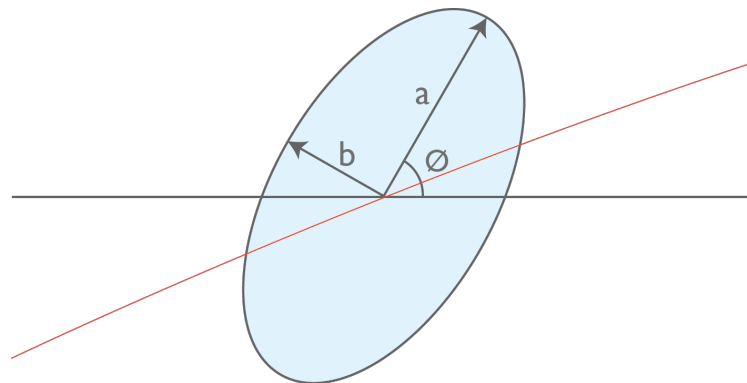


Table 21.

Part Number	Nominal ANSI CCT	Color Space	Center Point (cx, cy)	Major Axis, a	Minor Axis, b	Ellipse Rotation Angle
LXZ1-4070-XXXX	4000K	Single 5-step MacAdam ellipse	(0.3818, 0.3797)	0.01565	0.00670	53.7

Company Information

Philips Lumileds is a leading provider of LEDs for everyday lighting applications. The company's records for light output, efficacy and thermal management are direct results of the ongoing commitment to advancing solid-state lighting technology and enabling lighting solutions that are more environmentally friendly, help reduce CO₂ emissions and reduce the need for power plant expansion. Philips Lumileds LUXEON® LEDs are enabling never before possible applications in outdoor lighting, shop lighting, home lighting, consumer electronics, and automotive lighting.

Philips Lumileds is a fully integrated supplier, producing core LED material in all three base colors, (Red, Green, Blue) and white. Philips Lumileds has R&D centers in San Jose, California and in the Netherlands, and production capabilities in San Jose, Singapore and Penang, Malaysia. Founded in 1999, Philips Lumileds is the high flux LED technology leader and is dedicated to bridging the gap between solid-state technology and the lighting world. More information about the company's LUXEON LED products and solid-state lighting technologies can be found at www.philipslumileds.com.

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