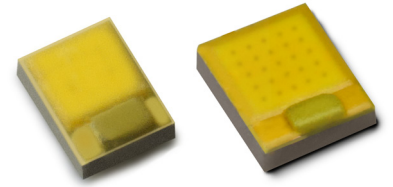


# LUXEON Z

## LUXEON Z ES

Breakthrough luminance, design flexibility  
and optical control for Illumination solutions



## Introduction

Philips Lumileds technology enables the new LUXEON® Z and LUXEON Z ES LEDs.

The LUXEON Z is a family of micro sized Illumination grade emitters that is the first ever I-step MacAdam Ellipse warm white LED that enables never before seen color consistency, luminance, flux density and design flexibility for next generation lighting solutions. LUXEON Z family is undomed, a feature that provides un-matched optical flexibility for precise beam angle control. Tested and binned at application conditions 85°C, the LUXEON Z and Z ES emitters are an ideal choice for indoor and outdoor light sources requiring superior beam angles, higher efficiency and lower costs.

### Features

- Micro sized: LUXEON Z, 1.3x1.7 mm and LUXEON Z ES, 1.6x2.0 mm
- Undomed device architecture
- Hot tested at 85°C
- Up to 1 A max drive current
- *Freedom from Binning*
- 1, 3, 5 step MCE options
- Lowest thermal resistance 3°C/W

### Benefits

- Highest luminance to deliver punch
- Ultimate design flexibility from micro form factor
- Precise optical control from an undomed architecture
- Enables small customizable and scalable light engines
- Leading system level lm/\$ proposition

### Key Applications

- Indoor area
- Lamps
  - MR16, PAR, GU10 and Candles
- Outdoor area
  - High-flux street light modules
- Specialty lighting
- Architectural

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# General Information

## Product Nomenclature

LUXEON Z and Z ES emitters are specified and binned under “hot” conditions comparable to those found in “real-world” lighting products. The test conditions for LUXEON Z ES and LUXEON Z are 700 mA DC and 500 mA DC respectively with junction temperature at 85°C

The part number designation is explained as follows:

L X Z n - a b c d - y

Where:

- n — 1 for LUXEON Z and 2 for LUXEON Z ES
- a, b — designates nominal ANSI CCT (27 for 2700K, 30 for 3000K, RB for Royal Blue)
- c, d — designates minimum CRI performance (7 for 70 CRI, 8 for 80 CRI, 9 for 90 CRI)
- y — 1 designates 1 SDCM, 3 designates 3 SDCM and 5 designates 5 SDCM (only for 80 and 90 CRI versions. Lower than equal to 70 CRI parts will not have a SDCM designate and all parts will be within 5 step MCE).

Therefore, 3 SDCM 2700K/80 CRI LUXEON Z ES will have the following part number:

L X Z 2 – 2 7 8 0 - 3

Therefore, 5 SDCM 3000K/80 CRI LUXEON Z will have the following part number:

L X Z 1 – 3 0 8 0 - 5

## Average Lumen Maintenance Characteristics

LUXEON Z products are tested in compliance with LM-80. Please visit [www.philipslumileds.com/support/documentation/lumen-maintenance](http://www.philipslumileds.com/support/documentation/lumen-maintenance) or contact your local Philips Lumileds Technical Solutions Manager for TM-21 extrapolations or other support.

## Environmental Compliance

Philips Lumileds is committed to providing environmentally friendly products to the solid-state lighting market.

LUXEON Z and LUXEON Z ES products are compliant to the European Union directives on the restriction of hazardous substances in electronic equipment, namely the RoHS and REACH directives. Philips Lumileds will not intentionally add the following restricted material to the LUXEON Z and LUXEON Z ES: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

# Product Selection

## Product Selection Guide for LUXEON Z ES Emitters Junction Temperature = 85°C

**Table 1.**

| LUXEON Z ES |                  | @ 700 mA      |               |         |           | @ 1A          |         |           | @ 350 mA      |         |           |
|-------------|------------------|---------------|---------------|---------|-----------|---------------|---------|-----------|---------------|---------|-----------|
| Part Number | Normal CCT / CRI | Min Flux (lm) | Typ flux (Lm) | Typ. Vf | Typ. Lm/W | Typ flux (Lm) | Typ. Vf | Typ. Lm/W | Typ flux (Lm) | Typ. Vf | Typ. Lm/W |
| LXZ2-2780-Y | 2700 / 80        | 160           | 175           | 2.85    | 88        | 224           | 2.90    | 77        | 99            | 2.77    | 102       |
| LXZ2-2790-Y | 2700 / 90        | 110           | 135           | 2.85    | 68        | 178           | 2.90    | 61        | 78            | 2.77    | 81        |
| LXZ2-3080-Y | 3000 / 80        | 160           | 180           | 2.85    | 91        | 238           | 2.90    | 82        | 104           | 2.77    | 108       |
| LXZ2-3090-Y | 3000 / 90        | 120           | 145           | 2.85    | 73        | 178           | 2.90    | 61        | 78            | 2.77    | 81        |
| LXZ2-3580-Y | 3500 / 80        | 170           | 190           | 2.85    | 95        | 244           | 2.90    | 84        | 107           | 2.77    | 111       |
| LXZ2-4080-Y | 4000 / 80        | 180           | 195           | 2.85    | 98        | 257           | 2.90    | 89        | 113           | 2.77    | 117       |
| LXZ2-4070   | 4000 / 70        | 190           | 210           | 2.85    | 106       | 277           | 2.90    | 96        | 122           | 2.77    | 126       |
| LXZ2-5070   | 5000 / 70        | 200           | 215           | 2.85    | 108       | 284           | 2.90    | 98        | 125           | 2.77    | 129       |
| LXZ2-5770   | 5700 / 70        | 200           | 215           | 2.85    | 108       | 284           | 2.90    | 98        | 125           | 2.77    | 129       |

**Notes for Table 1:**

1. All LUXEON Z ES emitters are tested and binned at 700 mA/85C.
2. Philips Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux and  $\pm 2$  on CRI measurements.

## Product Selection for LUXEON Z Emitters Junction Temperature = 85°C

**Table 2.**

| LUXEON Z    |                  | @ 500 mA      |               |         |           | @ 700 mA      |         |           | @ 350 mA      |         |           |
|-------------|------------------|---------------|---------------|---------|-----------|---------------|---------|-----------|---------------|---------|-----------|
| Part Number | Normal CCT / CRI | Min Flux (lm) | Typ flux (Lm) | Typ. Vf | Typ. Lm/W | Typ flux (Lm) | Typ. Vf | Typ. Lm/W | Typ flux (Lm) | Typ. Vf | Typ. Lm/W |
| LXZ1-2780-Y | 2700 / 80        | 90            | 105           | 2.85    | 74        | 134           | 2.89    | 66        | 81            | 2.81    | 82        |
| LXZ1-3080-Y | 3000 / 80        | 100           | 110           | 2.85    | 78        | 141           | 2.89    | 70        | 85            | 2.81    | 86        |
| LXZ1-4080-Y | 4000 / 80        | 100           | 126           | 2.85    | 89        | 161           | 2.89    | 80        | 97            | 2.81    | 99        |
| LXZ1-4070   | 4000 / 70        | 100           | 132           | 2.85    | 93        | 169           | 2.89    | 84        | 102           | 2.81    | 103       |
| LXZ1-5070   | 5000 / 70        | 110           | 142           | 2.85    | 100       | 182           | 2.89    | 90        | 109           | 2.81    | 111       |
| LXZ1-5770   | 5700 / 70        | 110           | 148           | 2.85    | 104       | 189           | 2.89    | 94        | 114           | 2.81    | 116       |
| LXZ1-6565   | 6500 / 65        | 110           | 135           | 2.85    | 95        | 173           | 2.89    | 85        | 104           | 2.81    | 106       |

**Notes for Table 2:**

1. All LUXEON Z emitters above are tested and binned at 500 mA/85C.
2. Philips Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux and  $\pm 2$  on CRI measurements.

# Optical Characteristics

## LUXEON Z ES at Test Current 700 mA, Junction Temperature 85°C & LUXEON Z at Test Current 500 mA, Junction Temperature 85°C

**Table 3.**

| Nominal ANSI CCT | Color Temperature CCT Typical | Typical Total Included Angle <sup>2</sup> (degrees) $\theta_{0.90V}$ | Typical Viewing Angle <sup>3</sup> (degrees) $2\theta_{1/2}$ |
|------------------|-------------------------------|--|--|
| 2700K            | 2725K                         | 160  | 120  |
| 3000K            | 3045K                         | 160  | 120  |
| 3500K            | 3465K                         | 160  | 120  |
| 4000K            | 3985K                         | 160  | 120  |
| 5000K            | 5028K                         | 160  | 120  |
| 5700K            | 5665K                         | 160  | 120  |

**Notes for Table 3:**

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

## LUXEON Z ES at Test Current 700 mA, Junction Temperature 85°C & LUXEON Z at Test Current 500 mA, Junction Temperature 85°C

**Table 4.**

| Nominal ANSI CCT | Forward Voltage V <sub>f</sub> <sup>1</sup> (V) |      | Typical 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) $R_{\theta_{j-c}}$ |
|------------------|---|------|---|--|
|                  | Min.  | Max. |   |  |
| 2700K            | 2.5   | 3.25 | -1.6  | 3  |
| 3000K            | 2.5   | 3.25 | -1.6  | 3  |
| 3500K            | 2.5   | 3.25 | -1.6  | 3  |
| 4000K            | 2.5   | 3.25 | -1.6  | 3  |
| 5000K            | 2.5   | 3.25 | -1.6  | 3  |
| 5700K            | 2.5   | 3.25 | -1.6  | 3  |
| 6500K            | 2.5   | 3.25 | -1.6  | 3  |

**Notes for Table 4:**

1. Philips Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
2. Measured between  $T_j = 25^\circ\text{C}$  and  $T_j = 110^\circ\text{C}$  at  $I_f = 700\text{ mA}$ .

## Absolute Maximum Ratings

**Table 5.**

| Parameter                                       | LUXEON Z ES   | LUXEON Z   |
|---|---|--|
| DC Forward Current (mA) <sup>1,2</sup>          | 1050  | 700  |
| Peak Pulsed Forward Current (mA) <sup>1,3</sup> | 1200  | 1000   |
| ESD Sensitivity                                 | < 8000V Human Body Model (HBM)<br>Class 3A JESD22-A114-E    | < 8000V Human Body Model (HBM)<br>Class 3A JESD22-A114-E |
| LED Junction Temperature <sup>1</sup>           | 135°C   | 135°C  |
| Operating Case Temperature at 700 mA            | -40°C - 135°C   | -40°C - 135°C  |
| Storage Temperature                             | -40°C - 135°C   | -40°C - 135°C  |
| Soldering Temperature                           | JEDEC 020c 260°C  | JEDEC 020c 260°C   |
| Allowable Reflow Cycles                         | 3   | 3  |
| Reverse Voltage (Vr) <sup>5,6</sup>             | LUXEON Z LEDs are not designed to be driven in reverse bias |  |

**Notes for Table 5:**

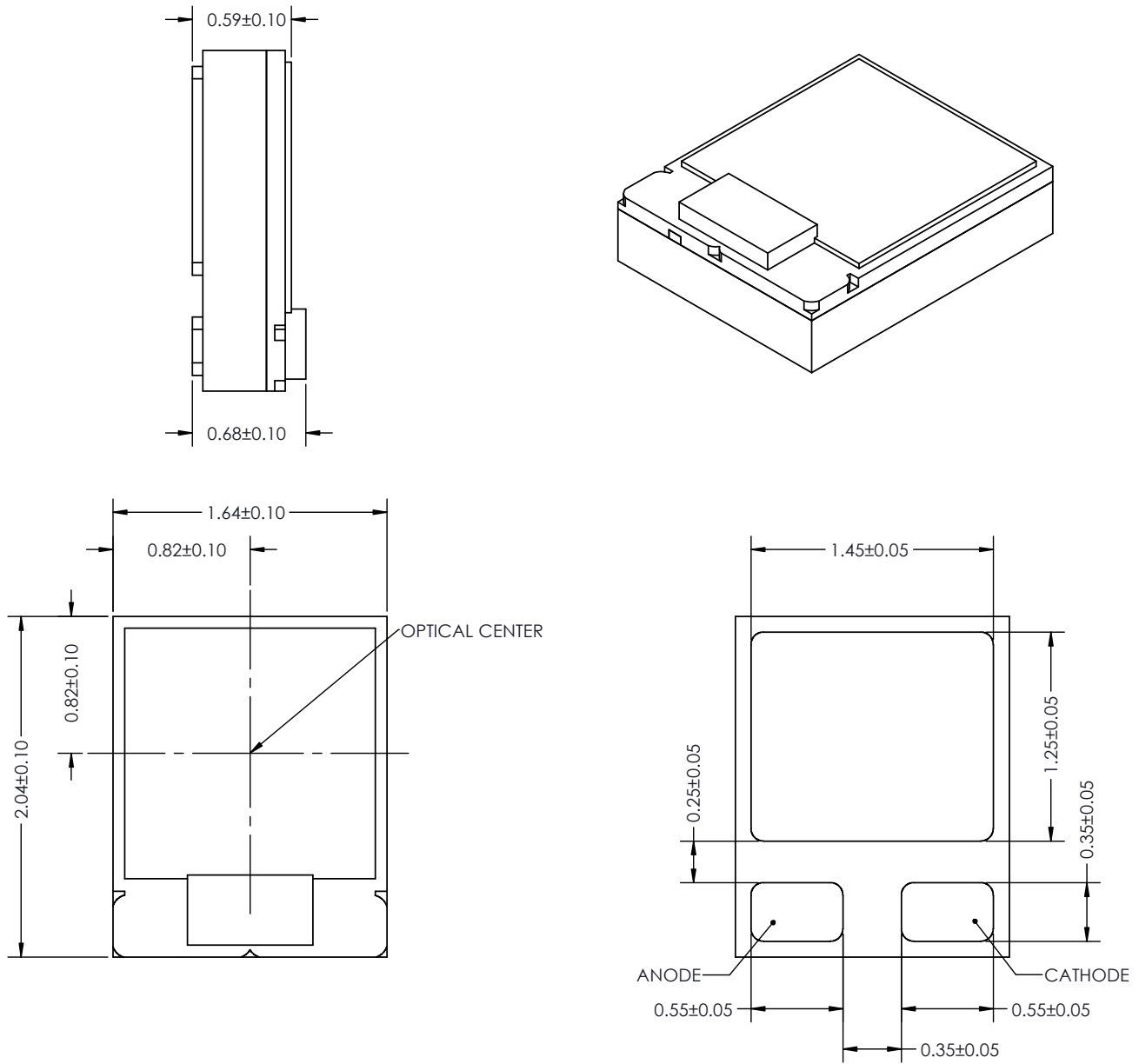
- Proper current derating must be observed to maintain junction temperature below the maximum. For additional information on thermal measurement guidelines please refer to Application Brief AB106.
- Residual periodic variations due to power conversion from alternating current (AC) to direct current (DC), also called "ripple", with frequencies  $\geq 100$  Hz and amplitude  $\leq 200$  mA are acceptable, assuming the average current throughout each cycle does not exceed 1000 mA.
- Pulsed operation with a peak drive current of 1200 mA is acceptable if the pulse on-time is  $\leq 5$  ms per cycle and the duty cycle is  $\leq 50\%$ .
- 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 200 $\mu$ A.
- Max 5V reverse for up to 10s is an acceptable beginning of life, one time test condition.

## JEDEC Moisture Sensitivity

**Table 6.**

| Level | Floor Life |                                     | Soak Requirements Standard |                  |
|-------|------------|-------------------------------------|----------------------------|------------------|
|       | Time       | Conditions                          | Time                       | Conditions       |
| I     | unlimited  | $\leq 30^\circ\text{C}$ /<br>85% RH | 168h<br>+ 5 / - 0          | 85°C / 85%<br>RH |

# Mechanical Dimensions of LUXEON Z ES

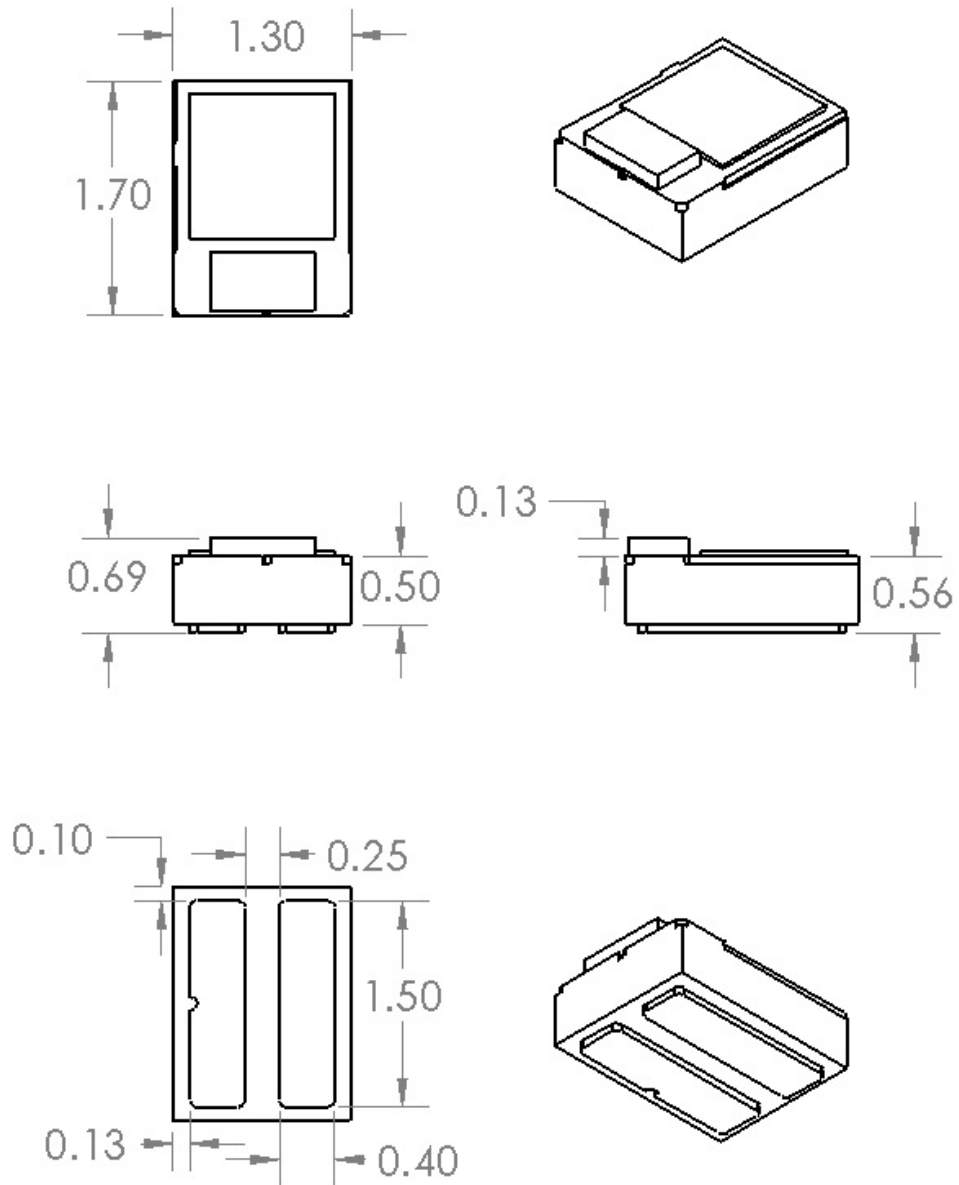


**Figure 1. Package outline drawing for LUXEON Z ES.**

**Notes for Figure 1:**

1. Do not handle the device by the lens. Excessive force on the lens may damage the lens itself or the interior of the device.
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.

# Mechanical Dimensions of LUXEON Z



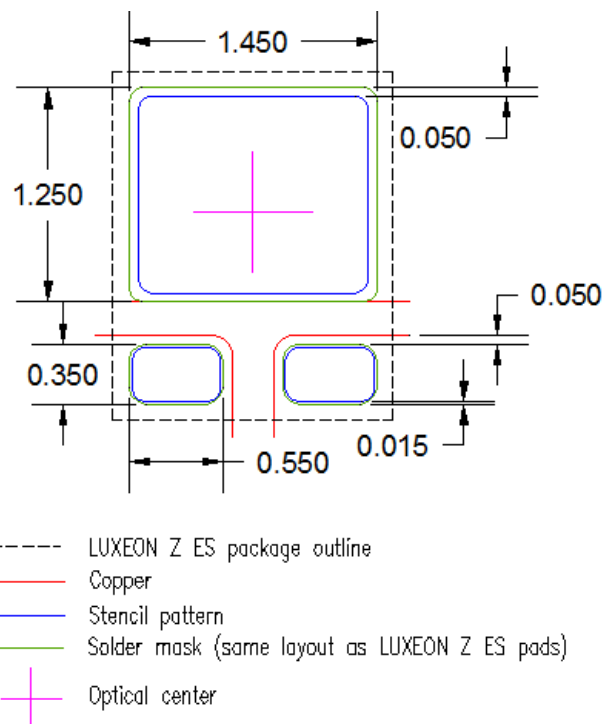
**Figure 2. Package outline drawing for LUXEON Z.**

**Notes for Figure 2:**

1. Do not handle the device by the lens. Excessive force on the lens may damage the lens itself or the interior of the device.
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.



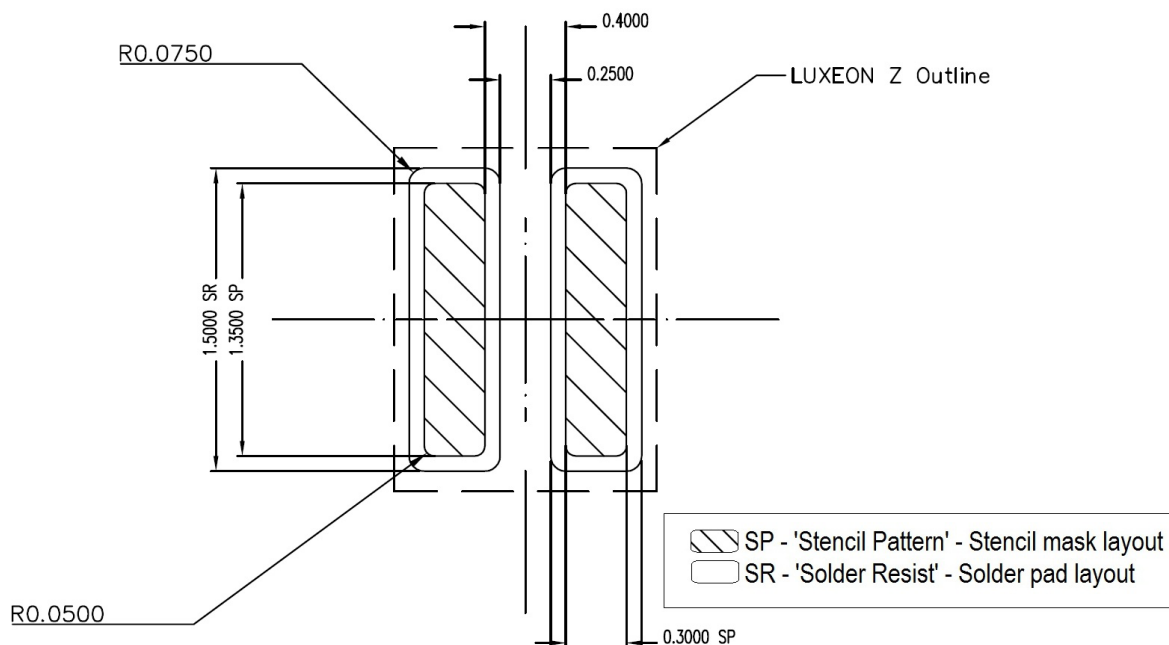
# Solder Pad Design



**Figure 3. Layout design B. Recommended PCB footprint for LUXEON Z ES for high component count density based on solder mask defined pads. Dimensions in mm..**

## Notes for Figure 3:

1. The drawing above shows the recommended solder pad layout on Printed Circuit Board (PCB).
2. Application Brief AB202 provides extensive details for this layout. In addition, the .dwg files are available at [www.philipslumileds.com](http://www.philipslumileds.com) and [www.philipslumileds.cn.com](http://www.philipslumileds.cn.com).



**Figure 4. Solder pad layout for LUXEON Z.**

# Relative Spectral Distribution

## Relative Spectral Distribution vs. Wavelength Characteristics

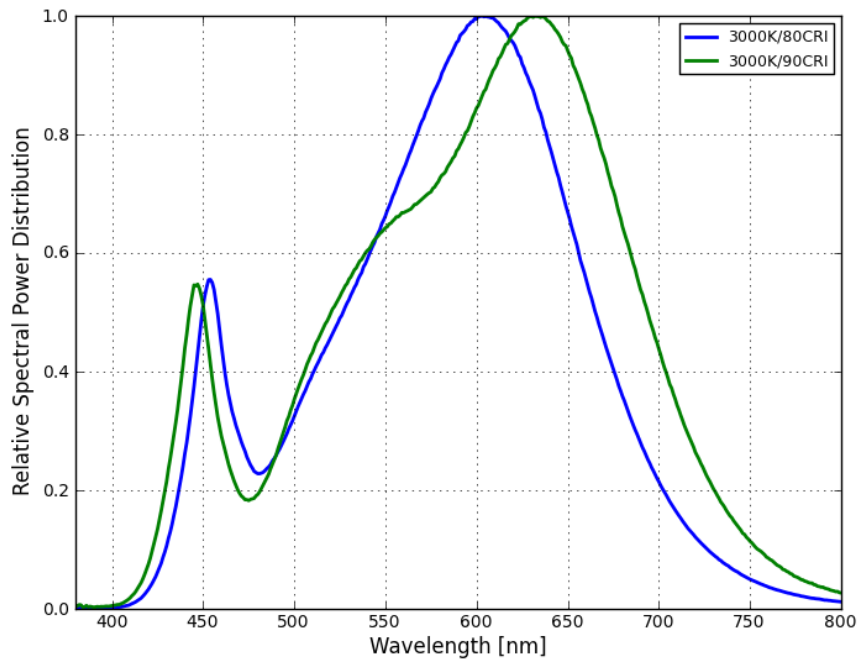


Figure 5.

# Light Output Characteristics

Relative Light Output vs. Thermal Pad Temperature for LUXEON Z ES,  
Test Current at 700 mA

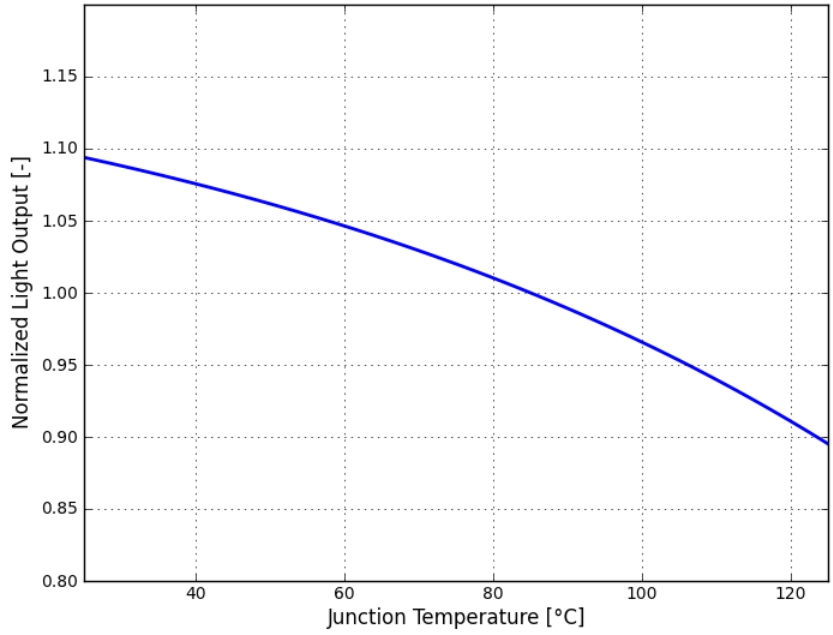


Figure 6.

Relative Light Output vs. Forward Current for LUXEON Z ES,  
Thermal Pad temperature = 85°C

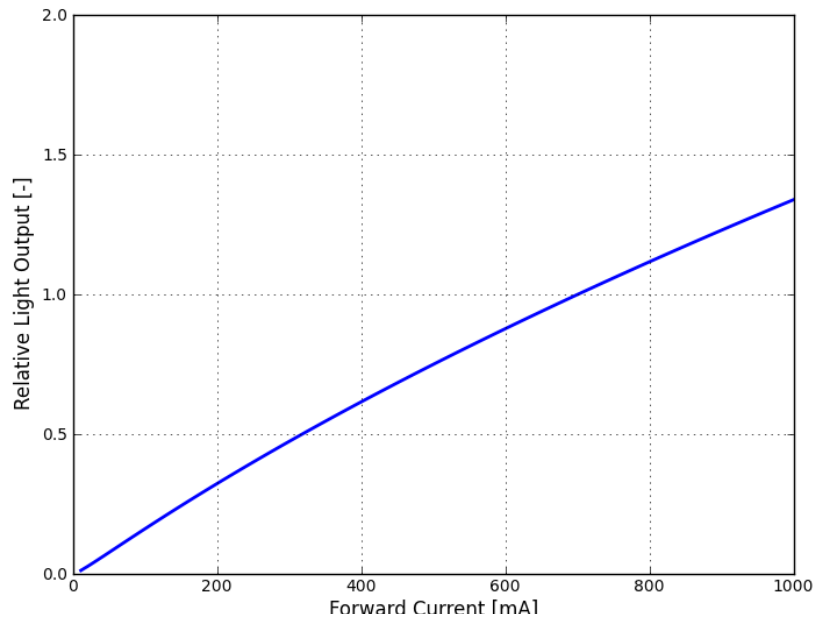


Figure 7.

Forward Current Characteristics for LUXEON Z ES,  
Thermal Pad Temperature = 85°C

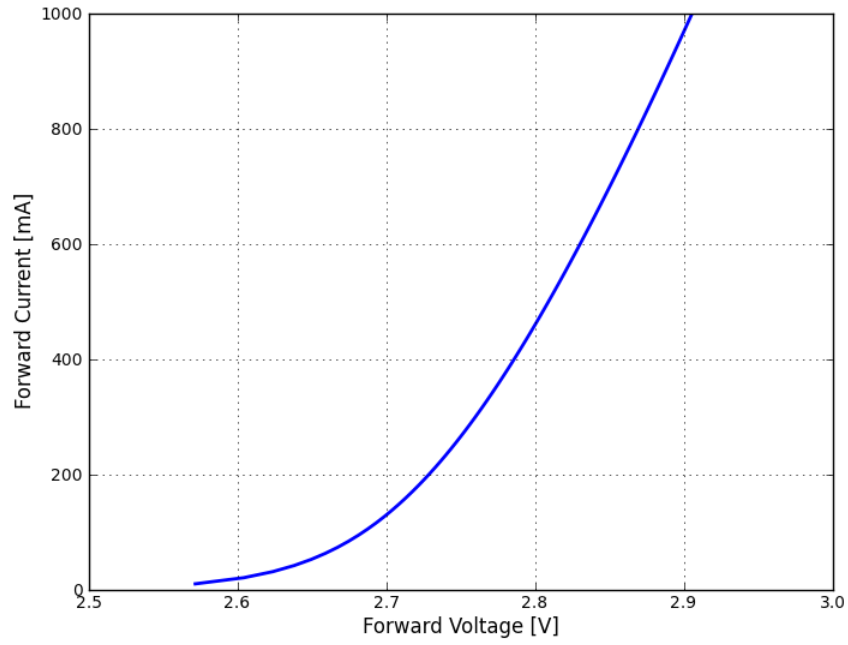


Figure 8.

## Relative Light Output vs. Thermal Pad Temperature for LUXEON Z White, Test Current at 500 mA

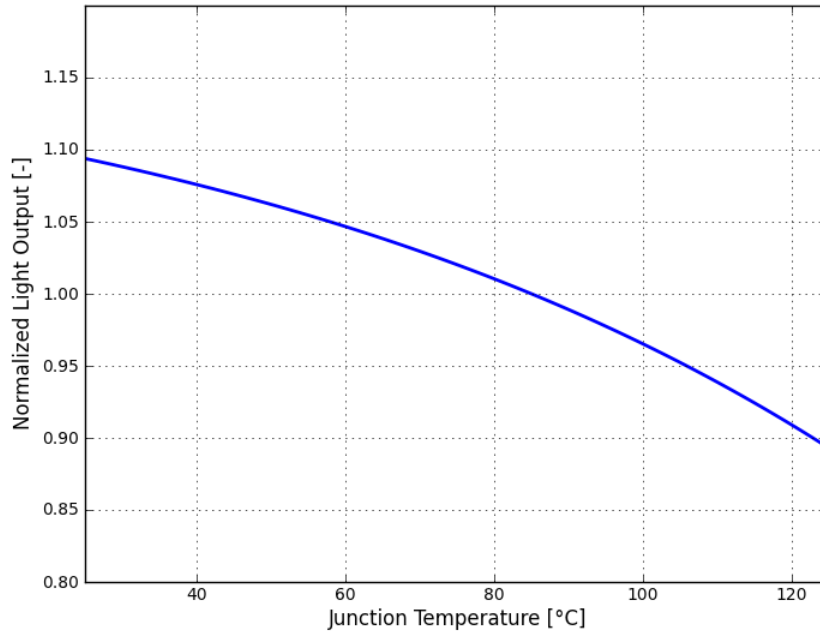


Figure 9.

## Relative Light Output vs. Forward Current for LUXEON Z White, Thermal Pad Temperature = 85°C

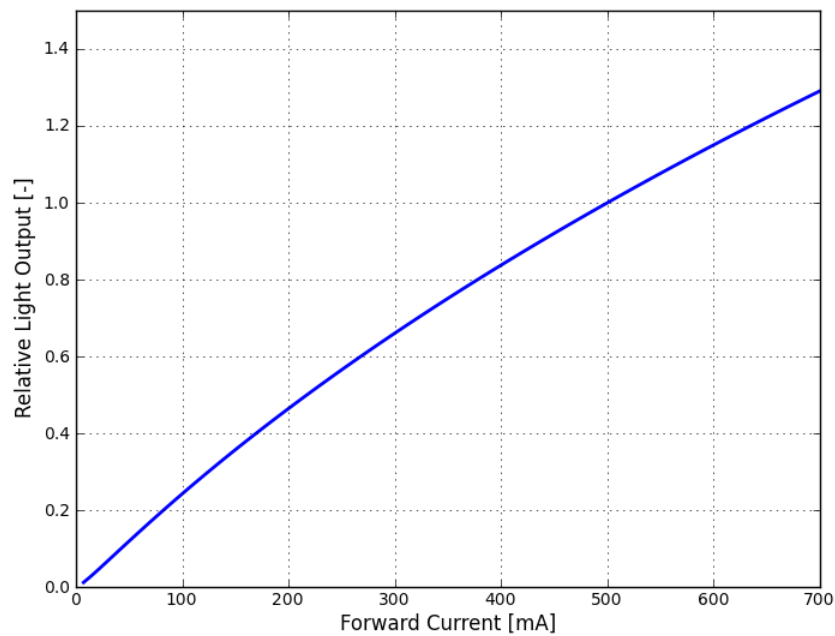


Figure 10.

Forward Current Characteristics for LUXEON Z White,  
Thermal Pad Temperature = 85°C

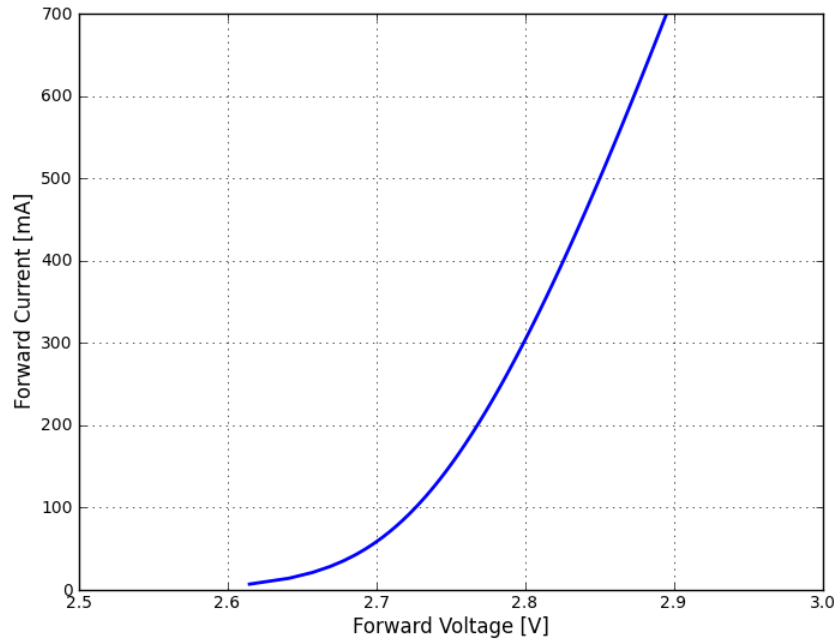


Figure 11.

# Typical Spatial Radiation Pattern

## LUXEON Z ES

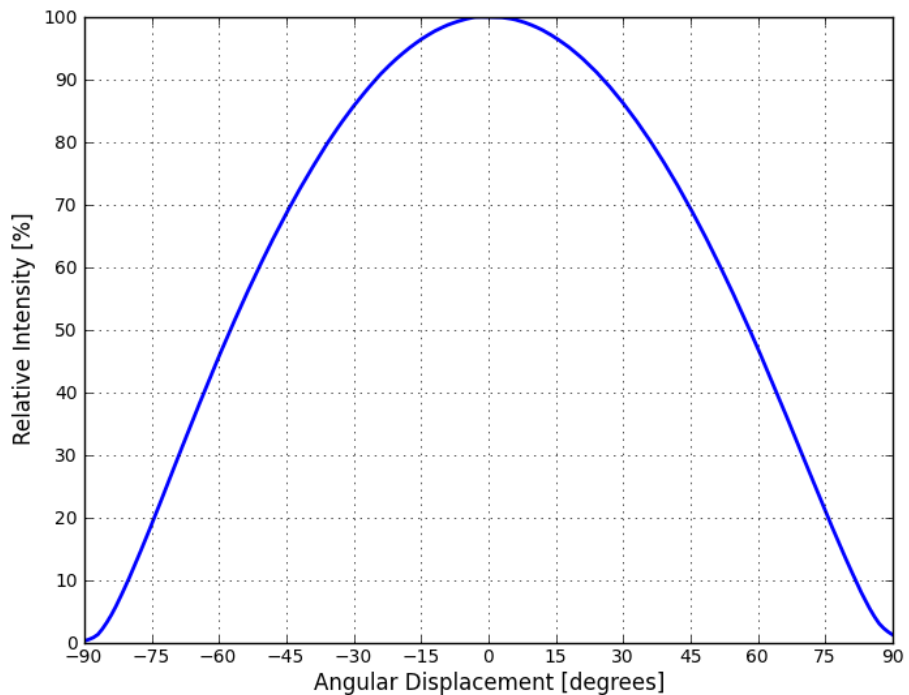


Figure 12.

## LUXEON Z ES Typical Polar Radiation Pattern

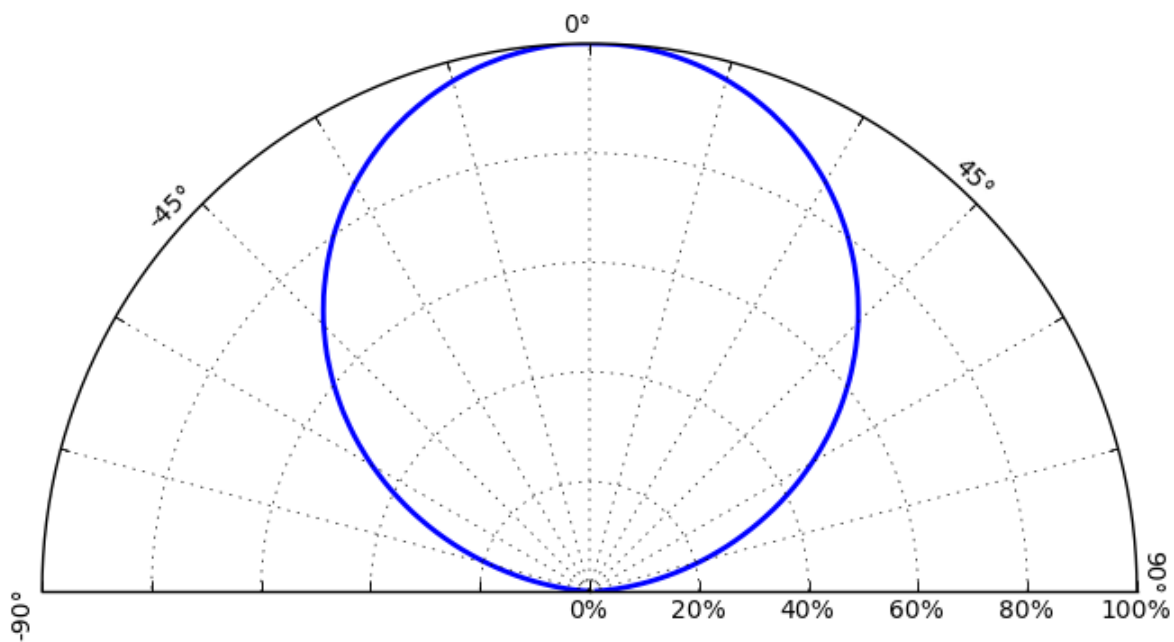


Figure 13.

# Typical Spatial Radiation Pattern

## LUXEON Z

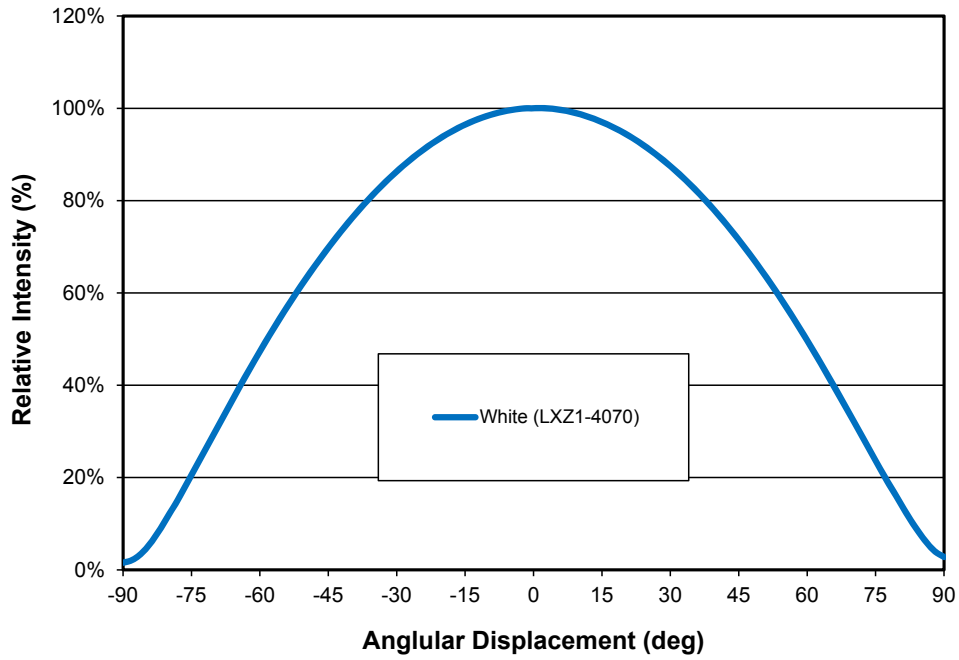


Figure 14.

## LUXEON Z Typical Polar Radiation Pattern

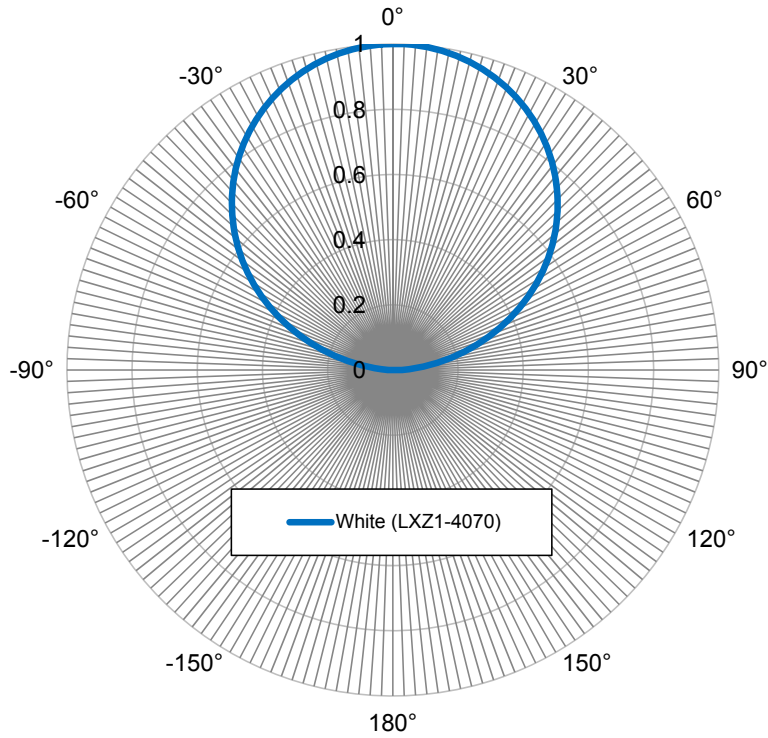


Figure 15.



# Emitter Pocket Tape Packaging for LUXEON Z ES

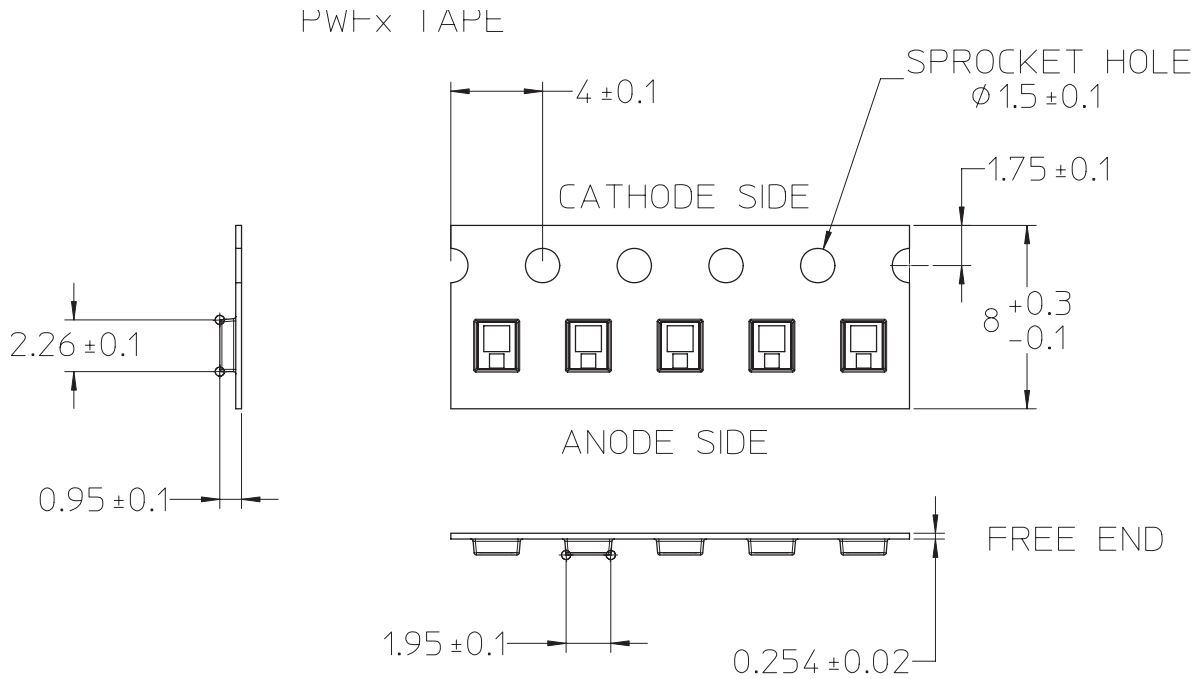


Figure 16. Emitter pocket tape packaging for LUXEON Z ES.

Notes for Figure 16:

1. All dimensions are in millimeters

# Emitter Reel Packaging for LUXEON Z ES

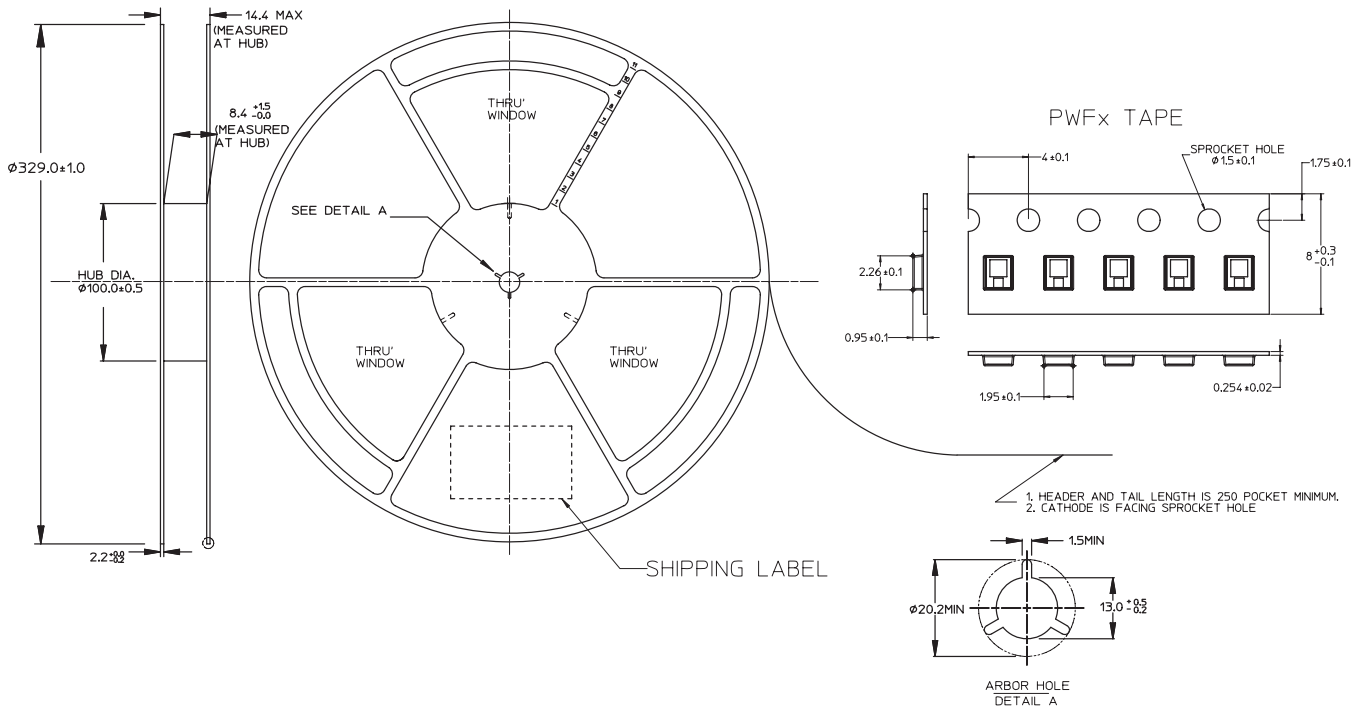
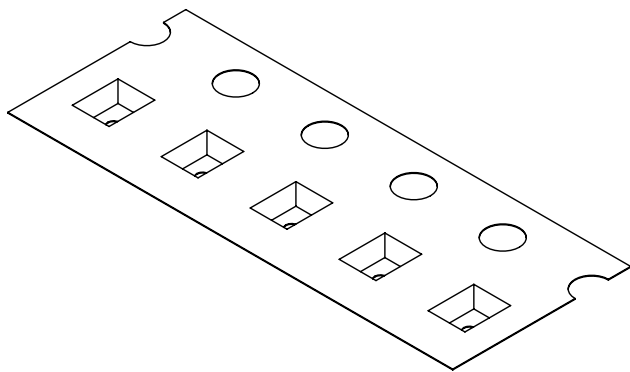
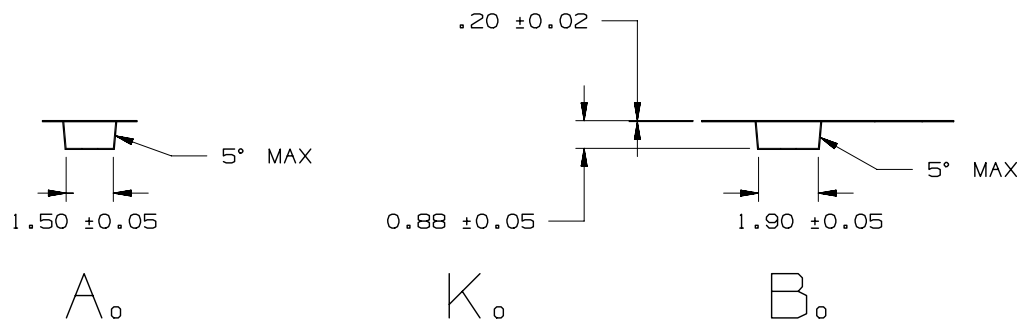
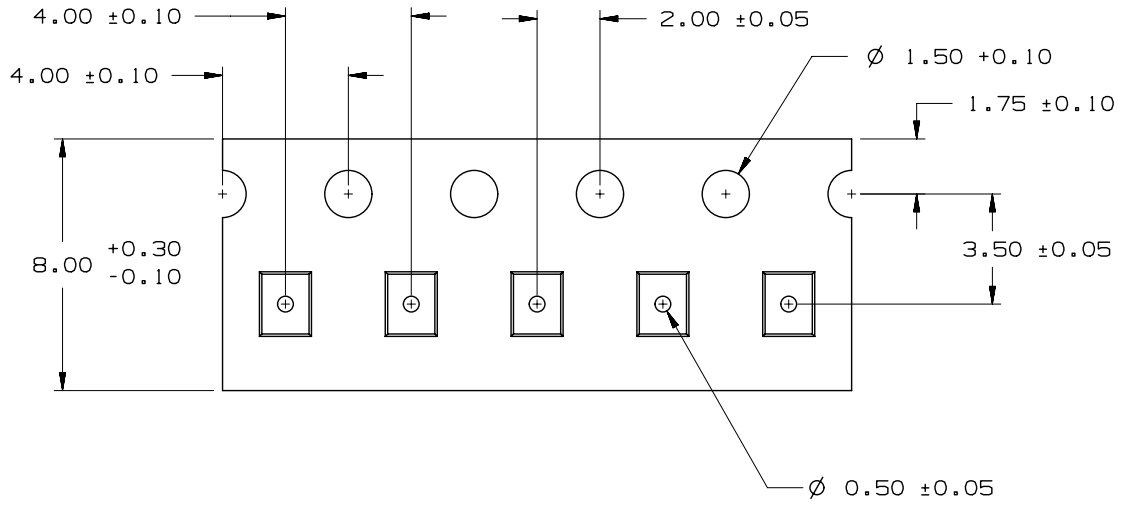


Figure 17. Emitter reel packaging for LUXEON Z ES.

# Emitter Pocket Tape Packaging for LUXEON Z



**Figure 18. Emitter pocket tape packaging for LUXEON Z.**

**Notes for Figure 18:**

- I. All dimensions are in millimeters

# Emitter Reel Packaging for LUXEON Z

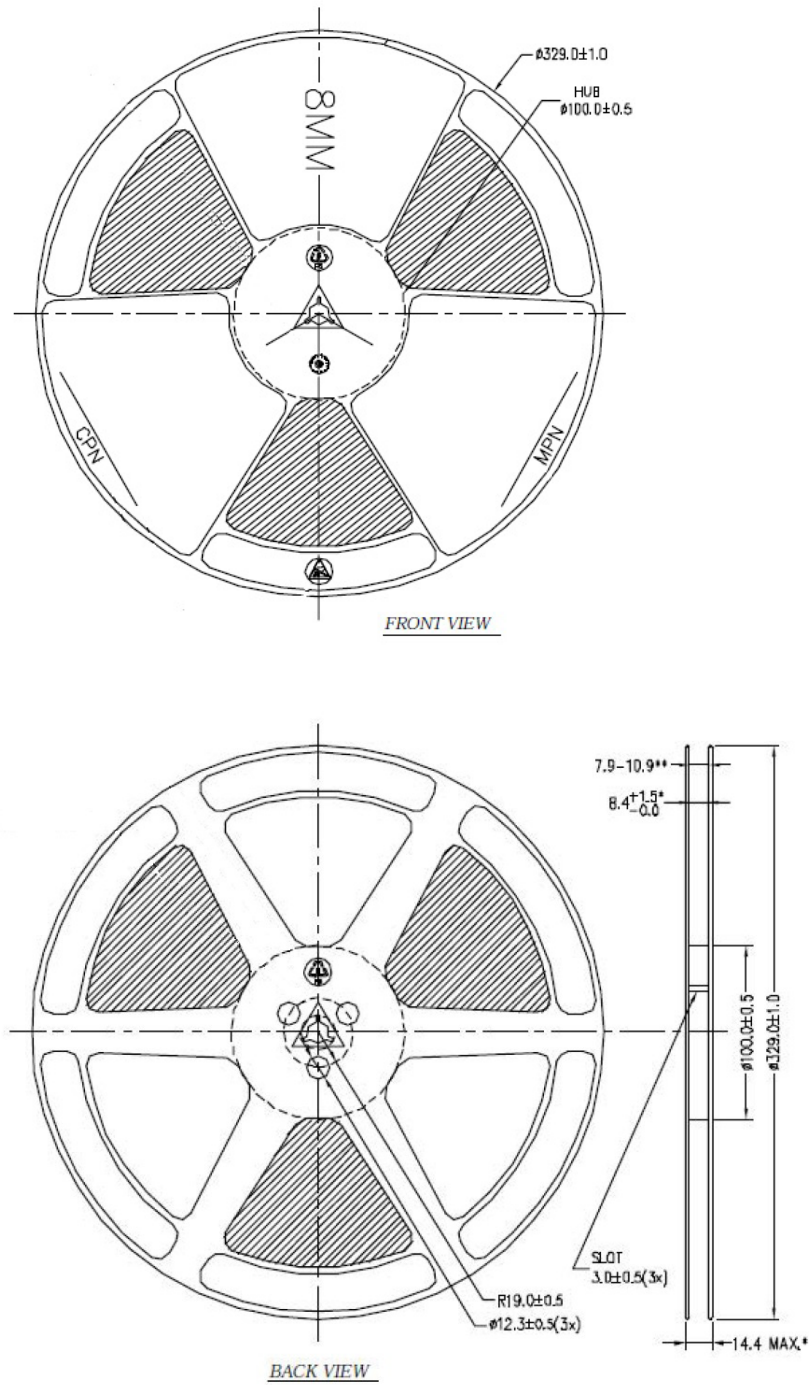


Figure 19. Emitter reel packaging for LUXEON Z.

# Product Binning and Labeling

## Purpose of Product Binning

In the manufacturing of semiconductor products, there are variations in performance around the average values given in the technical data sheets. For this reason, Philips Lumileds bins the LED components for luminous flux and forward voltage ( $V_f$ ). Color is offered in a single 1 step, 3-step or 5-step MacAdam ellipse color space centered on the ANSI CCT color bins. For additional information please review the MacAdam ellipse technical definition section.

## Decoding Product Bin Labeling

LUXEON Z ES and LUXEON Z 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. Reels of LUXEON Z emitters are labeled with a four digit alphanumeric CAT code following the format below.

ABCD

A = Flux/Radiometric power bin (L, M, etc.)

B and C = Color Bin (5A, 5B, 5C, 5D, 3U, 3L, 0I)

D =  $V_f$  bin (P,R)

## Luminous Flux and Forward Voltage Bins

Table 7 lists the standard photometric luminous flux bins for LUXEON Z ES and LUXEON Z emitters (tested and binned at 700 mA and 500 mA  $T_j = 85^\circ\text{C}$ ). 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**

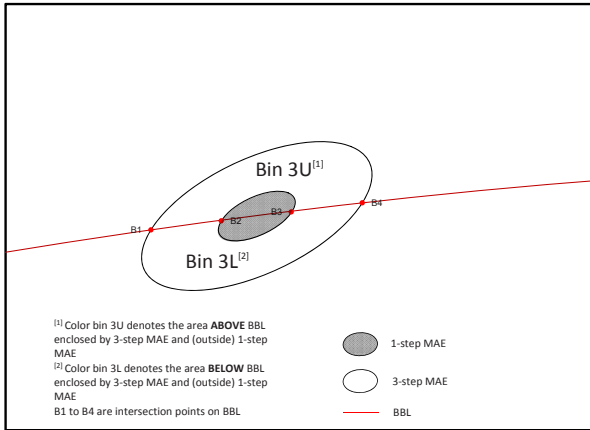
| Bin Code | Minimum Photometric Flux (lm) | Maximum Photometric Flux (lm) |
|----------|-------------------------------|-------------------------------|
| A        | 100                           | 110                           |
| B        | 110                           | 120                           |
| C        | 120                           | 130                           |
| 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                           |

Table 8 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.

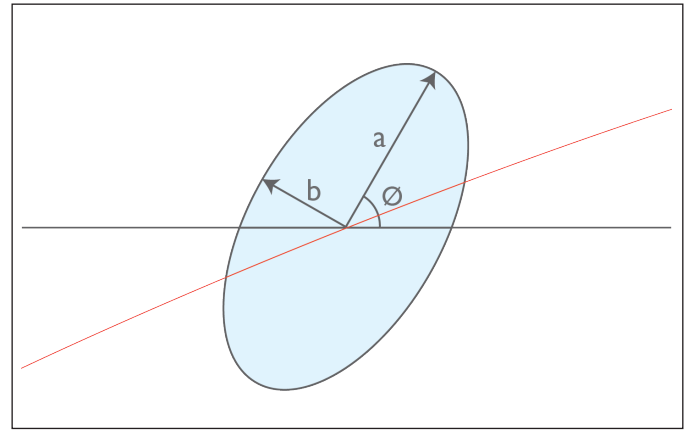
**Table 8.  $V_f$  Bins**

| Bin Code | Minimum Forward Voltage (V) | Maximum Forward Voltage (V) |
|----------|-----------------------------|-----------------------------|
| P        | 2.50                        | 2.75                        |
| R        | 2.75                        | 3.00                        |
| S        | 3.00                        | 3.25                        |

# LUXEON Z and LUXEON Z ES: 1-step, 3-step (above and below blackbody) and 5-step MacAdam Ellipse Color Definition



Color Space Definition for Above and Below Blackbody



Parameter Definition of MacAdam Ellipse

Table 9. LUXEON Z and LUXEON Z ES 1-step MacAdam Ellipse Parameters

| Nominal ANSI CCT | Color Space                   | Center Point (cx, cy) | Major Axis, a | Minor Axis, b | Ellipse Rotation Angle |
|------------------|-------------------------------|-----------------------|---------------|---------------|------------------------|
| 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                  |

Table 10. LUXEON Z and LUXEON Z ES 3-step MacAdam Ellipse Parameters

| Nominal ANSI CCT | Color Space                   | Center Point (cx, cy) | Major Axis, a | Minor Axis, b | Ellipse Rotation Angle |
|------------------|-------------------------------|-----------------------|---------------|---------------|------------------------|
| 2700K            | Single 3-step MacAdam ellipse | (0.4578, 0.4101)      | 0.00810       | 0.00420       | 53.7                   |
| 3000K            | Single 3-step MacAdam ellipse | (0.4338, 0.4030)      | 0.00834       | 0.00408       | 53.2                   |
| 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       | 53.7                   |
| 5000K            | Single 3-step MacAdam ellipse | (0.3447, 0.3553)      | 0.00822       | 0.00354       | 59.6                   |

Table 11. LUXEON Z and LUXEON Z ES 5-step MacAdam Ellipse Parameters

| Nominal ANSI CCT | Color Space                   | Center Point (cx, cy) | Major Axis, a | Minor Axis, b | Ellipse Rotation Angle |
|------------------|-------------------------------|-----------------------|---------------|---------------|------------------------|
| 2700K            | Single 5-step MacAdam ellipse | (0.4578, 0.4101)      | 0.01350       | 0.00700       | 53.7                   |
| 3000K            | Single 5-step MacAdam ellipse | (0.4338, 0.4030)      | 0.01390       | 0.00680       | 53.2                   |
| 3500K            | Single 5-step MacAdam ellipse | (0.4073, 0.3917)      | 0.01545       | 0.00690       | 54.0                   |
| 4000K            | Single 5-step MacAdam ellipse | (0.3818, 0.3797)      | 0.01565       | 0.00670       | 53.7                   |
| 5000K            | Single 5-step MacAdam ellipse | (0.3447, 0.3553)      | 0.01370       | 0.00590       | 59.6                   |
| 5700K            | Single 5-step MacAdam ellipse | (0.3287, 0.3417)      | 0.01243       | 0.00533       | 59.09                  |

Note for Tables 9, 10 & 11:

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



## 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 CO<sub>2</sub> 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, digital imaging, display 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](http://www.philipslumileds.com).

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LUXEON Z and LUXEON Z ES Datasheet DS120 20130517



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