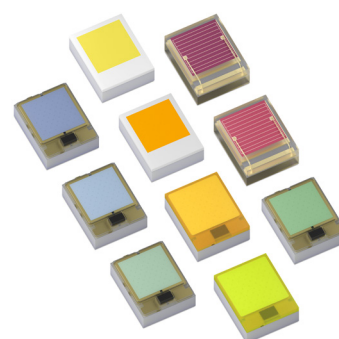


# LUXEON CZ ES Color Line

Maximum density and minimal area for complex color arrays

The LUXEON CZ ES Color Line has the smallest 2mm<sup>2</sup> die LEDs in the LUXEON family. Measuring only 2.0mm x 1.6mm in size, enables the maximum amount of LEDs to be packed in a small Light-Emitting Surface (LES). The 3-stripe foot print eases the PCB layout while ensuring a minimal LES with unprecedented color mixing potential. The undomed LED allows optics to be placed very close to its emitting surface. This device is optimized for use in architectural & entertainment lighting, and emergency vehicle lighting.



## FEATURES AND BENEFITS

- Max drive current - up to 2.5A
- High density placement in arrays
- Lambertian radiation pattern
- Suitable for mixing rod optics
- Excellent Rth with dedicated thermal pad
- Robust Durability with Class 3B ESD protection

## PRIMARY APPLICATIONS

- Spotlights
- Wall Wash
- Floodlights
- Landscape Lighting
- [More...](#)

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# General Product Information

## Product Test Conditions

LUXEON CZ ES Color Line LEDs are tested and binned with a DC drive current of 1000mA at a junction temperature,  $T_j$ , of 85°C.

## Part Number Nomenclature

Part numbers for LUXEON CZ ES Color Line follow the convention below:

L 1 C V – **A A A** 1 0 0 0 0 0 0 0 0 0

Where:

**A A A** – designates color (DRD=Deep Red, RED=Red, PCA=PC Amber, MNT=Mint, LME=Lime, GRN=Green, CYN=Cyan, BLU=Blue, RYL=Royal Blue)

Therefore, the following part number is used for a LUXEON CZ ES Red LED:

L 1 C V – **R E D** 1 0 0 0 0 0 0 0 0 0

Part numbers for LUXEON CZ ES White follow the convention below:

L 1 C V – **A A B B** 0 0 0 0 0 0 0 0 0 0

Where:

**A A** – designates nominal CCT (27=2700K, 30=3000K, 40=4000K, 57=5700K)

**B B** – designates minimum CRI (70=70CRI, 80=80CRI)

Therefore, the following part number is used for a LUXEON CZ ES White 4000K 80CRI LED:

L 1 C V – **4 0 8 0** 0 0 0 0 0 0 0 0 0 0

## 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 Holding B.V. is committed to providing environmentally friendly products to the solid-state lighting market. LUXEON CZ ES Color Line 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 Holding B.V. 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 CZ ES Colors at specified test current 1000mA, T<sub>j</sub>=85°C

| COLOR      | DOMINANT OR<br>PEAK WAVELENGTH <sup>[1]</sup> (nm) |         | LUMINOUS FLUX (lm) OR<br>RADIOMETRIC POWER <sup>[2]</sup> (mW) |         | PART<br>NUMBER     |
|------------|----------------------------------------------------|---------|----------------------------------------------------------------|---------|--------------------|
|            | MINIMUM                                            | MAXIMUM | MINIMUM                                                        | TYPICAL |                    |
| Deep Red   | 655                                                | 675     | 900                                                            | 1009    | L1CV-DRD1000000000 |
| Red        | 624                                                | 634     | 93                                                             | 109     | L1CV-RED1000000000 |
| PC Amber   | -                                                  | -       | 220                                                            | 269     | L1CV-PCA1000000000 |
| Mint       | -                                                  | -       | 383                                                            | 451     | L1CV-MNT1000000000 |
| Lime       | -                                                  | -       | 383                                                            | 466     | L1CV-LME1000000000 |
| Green      | 520                                                | 540     | 300                                                            | 345     | L1CV-GRN1000000000 |
| Cyan       | 490                                                | 510     | 180                                                            | 212     | L1CV-CYN1000000000 |
| Blue       | 465                                                | 485     | 90                                                             | 116     | L1CV-BLU1000000000 |
| Royal Blue | 440                                                | 460     | 1230                                                           | 1389    | L1CV-RYL1000000000 |

Notes for Table 1a:  
1. Lumileds maintains a tolerance of ±6.5% on luminous flux measurements. PC Amber, Mint and Lime are binned by chromaticity coordinates. Deep Red and Royal Blue are binned by peak wavelength. All other colors are binned by dominant wavelength.  
2. Deep Red and Royal Blue are binned by radiometric power. All other colors are binned by luminous flux.

Table 1b. Product performance of LUXEON CZ ES White at 1000mA, T<sub>j</sub>=85°C

| COLOR | NOMINAL<br>CCT | MINIMUM<br>CRI <sup>[1]</sup> | LUMINOUS FLUX <sup>[1]</sup> (lm) |         | TYPICAL LUMINOUS<br>EFFICACY (lm/W) | PART<br>NUMBER     |
|-------|----------------|-------------------------------|-----------------------------------|---------|-------------------------------------|--------------------|
|       |                |                               | MINIMUM                           | TYPICAL |                                     |                    |
| White | 5700K          | 70                            | 315                               | 370     | 125                                 | L1CV-5770000000000 |
|       | 2700K          | 80                            | 264                               | 310     | 105                                 | L1CV-2780000000000 |
|       | 3000K          | 80                            | 280                               | 320     | 108                                 | L1CV-3080000000000 |
|       | 4000K          | 80                            | 295                               | 347     | 118                                 | L1CV-4080000000000 |
|       | 5700K          | 80                            | 300                               | 350     | 119                                 | L1CV-5780000000000 |

Notes for Table 1b:  
1. Lumileds maintains a tolerance of ±2 on CRI and ±6.5% on luminous flux measurements.

# Optical Characteristics

Table 2a. Optical characteristics for LUXEON CZ ES Colors at 1000mA, T<sub>j</sub>=85°C

| COLOR      | PART NUMBER        | TYPICAL SPECTRAL HALF-WIDTH <sup>[1]</sup><br>(nm) | TYPICAL TEMPERATURE COEFFICIENT OF DOMINANT OR PEAK WAVELENGTH<br>(nm/°C) | TYPICAL TOTAL INCLUDED ANGLE <sup>[2]</sup> | TYPICAL VIEWING ANGLE <sup>[3]</sup> |
|------------|--------------------|----------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------|--------------------------------------|
| Deep Red   | L1CV-DRD1000000000 | 21                                                 | 0.16                                                                      | 146                                         | 138                                  |
| Red        | L1CV-RED1000000000 | 18                                                 | 0.05                                                                      | 145                                         | 134                                  |
| PC Amber   | L1CV-PCA1000000000 | 75                                                 | -0.01                                                                     | 137                                         | 117                                  |
| Mint       | L1CV-MNT1000000000 | 114                                                | 0.00                                                                      | 139                                         | 120                                  |
| Lime       | L1CV-LME1000000000 | 102                                                | 0.01                                                                      | 138                                         | 119                                  |
| Green      | L1CV-GRN1000000000 | 33                                                 | 0.04                                                                      | 138                                         | 121                                  |
| Cyan       | L1CV-CYN1000000000 | 29                                                 | 0.02                                                                      | 138                                         | 120                                  |
| Blue       | L1CV-BLU1000000000 | 28                                                 | 0.03                                                                      | 138                                         | 122                                  |
| Royal Blue | L1CV-RYL1000000000 | 20                                                 | 0.04                                                                      | 138                                         | 121                                  |

**Notes for Table 2a:**

1. Spectral half-width is the spectral bandwidth at 50% of the peak intensity.
2. Total angle at which 90% of total luminous flux is captured.
3. Viewing angle is the off axis angle from the LED centerline where the luminous intensity is ½ of the peak value.

Table 2b. Optical characteristics for LUXEON CZ ES White at 1000mA, T<sub>j</sub>=85°C

| COLOR | PART NUMBER        | TYPICAL TOTAL INCLUDED ANGLE <sup>[1]</sup> | TYPICAL VIEWING ANGLE <sup>[2]</sup> |
|-------|--------------------|---------------------------------------------|--------------------------------------|
| White | L1CV-xxx0000000000 | 138                                         | 119                                  |

**Notes for Table 2b:**

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 3. Electrical and thermal characteristics for LUXEON CZ ES Color Line at 1000mA, T<sub>j</sub>=85°C

| COLOR      | PART NUMBER        | FORWARD VOLTAGE <sup>[1]</sup> (V <sub>f</sub> ) |         |         | TYPICAL TEMPERATURE COEFFICIENT OF FORWARD VOLTAGE <sup>[2]</sup> (mV/°C) | TYPICAL THERMAL RESISTANCE—JUNCTION TO SOLDER PAD (°C/W) |
|------------|--------------------|--------------------------------------------------|---------|---------|---------------------------------------------------------------------------|----------------------------------------------------------|
|            |                    | MINIMUM                                          | TYPICAL | MAXIMUM |                                                                           |                                                          |
| Deep Red   | L1CV-DRD1000000000 | 2.00                                             | 2.20    | 2.80    | -0.5                                                                      | 1.2                                                      |
| Red        | L1CV-RED1000000000 | 2.00                                             | 2.20    | 2.80    | -1.6                                                                      | 1.6                                                      |
| PC Amber   | L1CV-PCA1000000000 | 2.50                                             | 2.95    | 3.30    | -1.9                                                                      | 2.6                                                      |
| Mint       | L1CV-MNT1000000000 | 2.50                                             | 2.95    | 3.30    | -1.9                                                                      | 2.1                                                      |
| Lime       | L1CV-LME1000000000 | 2.50                                             | 2.95    | 3.30    | -1.7                                                                      | 2.2                                                      |
| Green      | L1CV-GRN1000000000 | 2.70                                             | 3.20    | 3.50    | -2.6                                                                      | 2.7                                                      |
| Cyan       | L1CV-CYN1000000000 | 2.70                                             | 3.37    | 3.50    | -3.1                                                                      | 2.5                                                      |
| Blue       | L1CV-BLU1000000000 | 2.70                                             | 3.37    | 3.50    | -3.5                                                                      | 2.3                                                      |
| Royal Blue | L1CV-RYL1000000000 | 2.50                                             | 2.95    | 3.30    | -1.8                                                                      | 1.7                                                      |
| White      | L1CV-xxx000000000  | 2.50                                             | 2.95    | 3.30    | -1.8                                                                      | 2.2                                                      |

**Notes for Table 3:**

1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
2. Measured between 25°C and 85°C.

## Absolute Maximum Ratings

Table 4. Absolute maximum ratings for LUXEON CZ ES Color Line

| PARAMETERS                                           | DEEP RED                                                  | RED AND PC AMBER | GREEN AND CYAN | BLUE AND ROYAL BLUE | MINT, LIME AND WHITE |
|------------------------------------------------------|-----------------------------------------------------------|------------------|----------------|---------------------|----------------------|
| DC Forward Current <sup>[1, 2]</sup>                 | 1400mA                                                    | 2500mA           | 2500mA         | 2500mA              | 2500mA               |
| Peak Pulsed Forward Current <sup>[1, 3]</sup>        | 1750mA                                                    | 3000mA           | 3000mA         | 3000mA              | 3000mA               |
| LED Junction Temperature <sup>[1]</sup> (DC & Pulse) | 135°C                                                     |                  |                |                     |                      |
| ESD Sensitivity (ANSI/ESDA/JEDEC JS-001-2012)        | Class 3B                                                  |                  |                |                     |                      |
| LED Storage Temperature                              | -40°C to 135°C                                            |                  |                |                     |                      |
| Soldering Temperature                                | JEDEC 020D 260°C                                          |                  |                |                     |                      |
| Allowable Reflow Cycles                              | 3                                                         |                  |                |                     |                      |
| Reverse Voltage (V <sub>reverse</sub> )              | LUXEON LEDs are not designed to be driven in reverse bias |                  |                |                     |                      |

**Notes for Table 4:**

1. Proper current derating must be observed to maintain the junction temperature below the maximum allowable junction temperature.
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. At 10% duty cycle with pulse width of 10ms.

# Characteristic Curves

## Spectral Power Distribution Characteristics

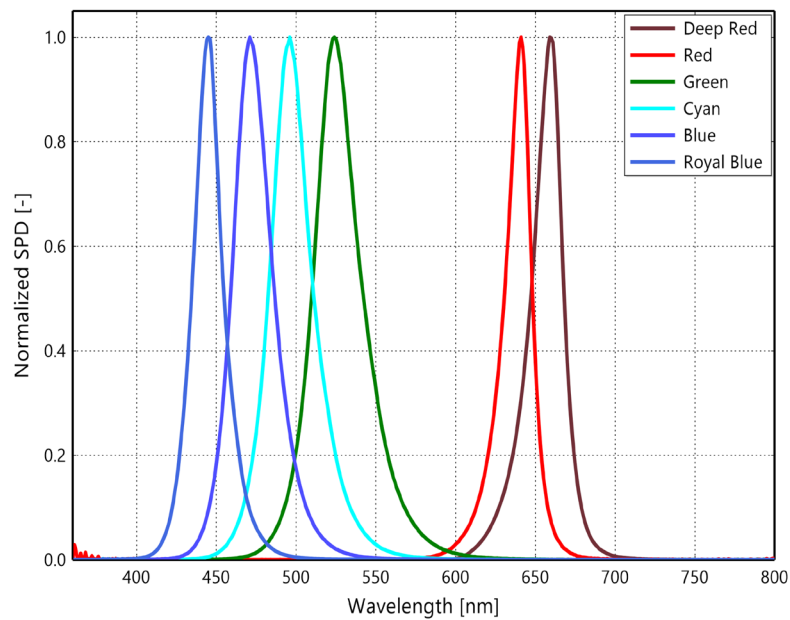


Figure 1a. Typical normalized SPD vs. wavelength for LUXEON CZ ES Direct Colors at 1000mA,  $T_j=85^{\circ}\text{C}$

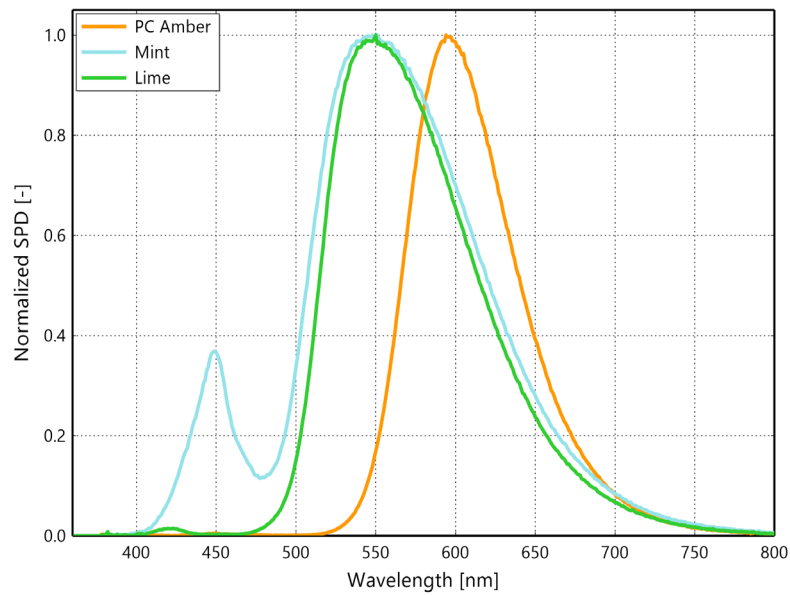


Figure 1b. Typical normalized SPD vs. wavelength for LUXEON CZ ES Phosphor Converted Colors at 1000mA,  $T_j=85^{\circ}\text{C}$

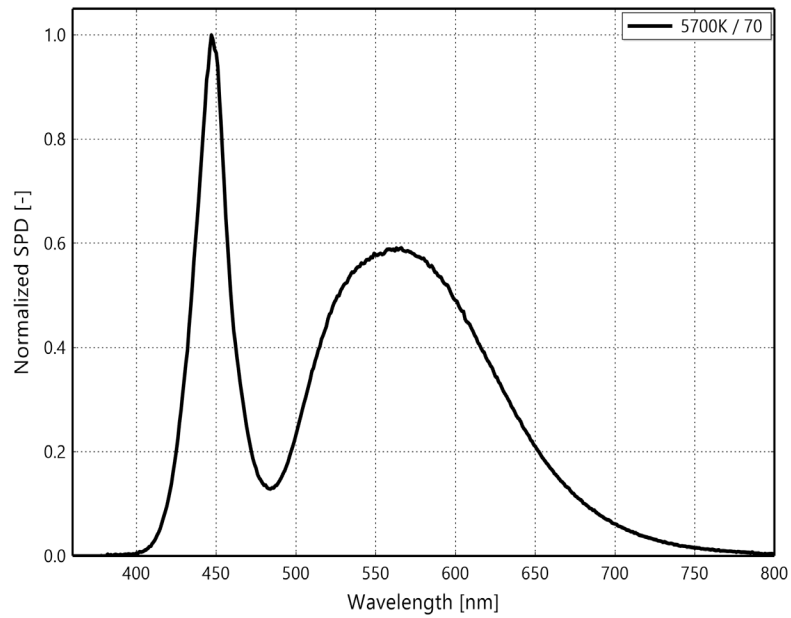


Figure 1c. Typical normalized SPD vs. wavelength for LUXEON CZ ES White 70CRI at 1000mA,  $T_j = 85^\circ\text{C}$

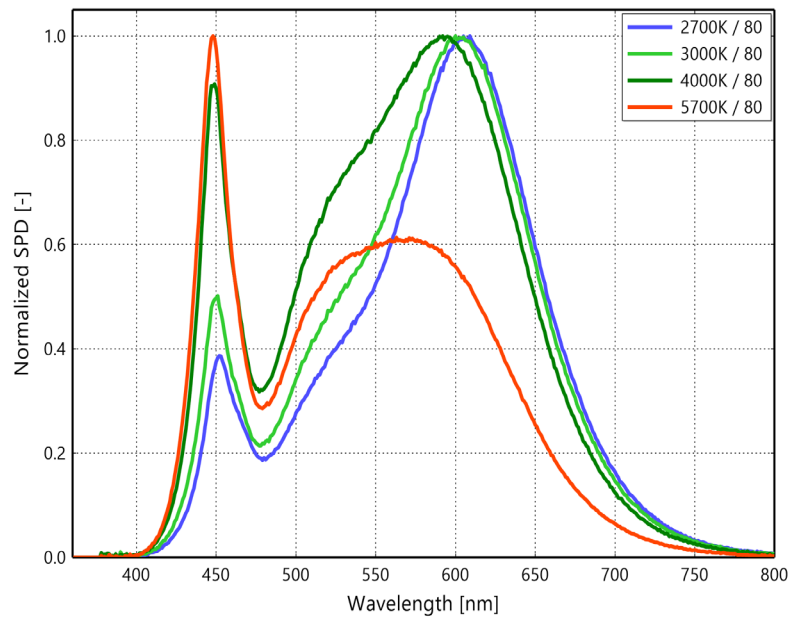


Figure 1d. Typical normalized SPD vs. wavelength for LUXEON CZ ES White 80CRI at 1000mA,  $T_j = 85^\circ\text{C}$

# Light Output Characteristics

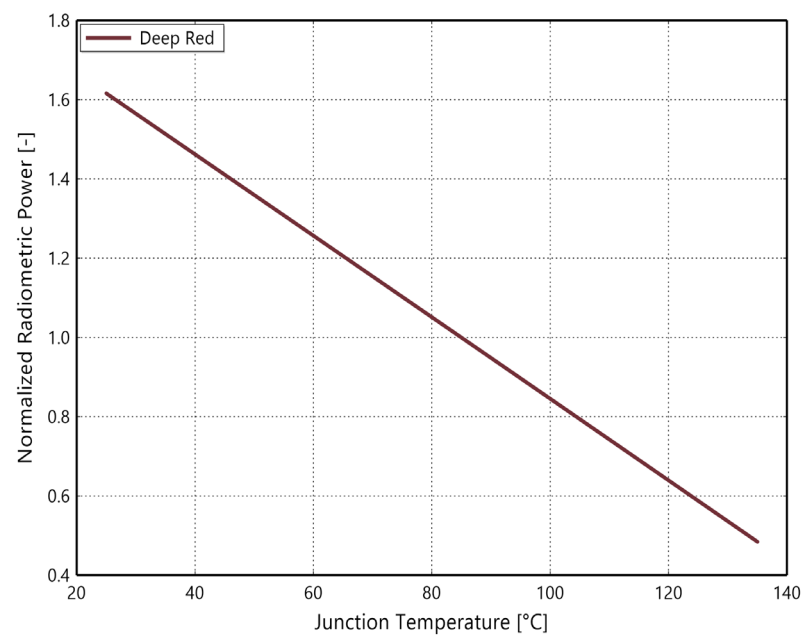


Figure 2a. Typical normalized radiometric power vs. junction temperature for LUXEON CZ ES Deep Red at 1000mA

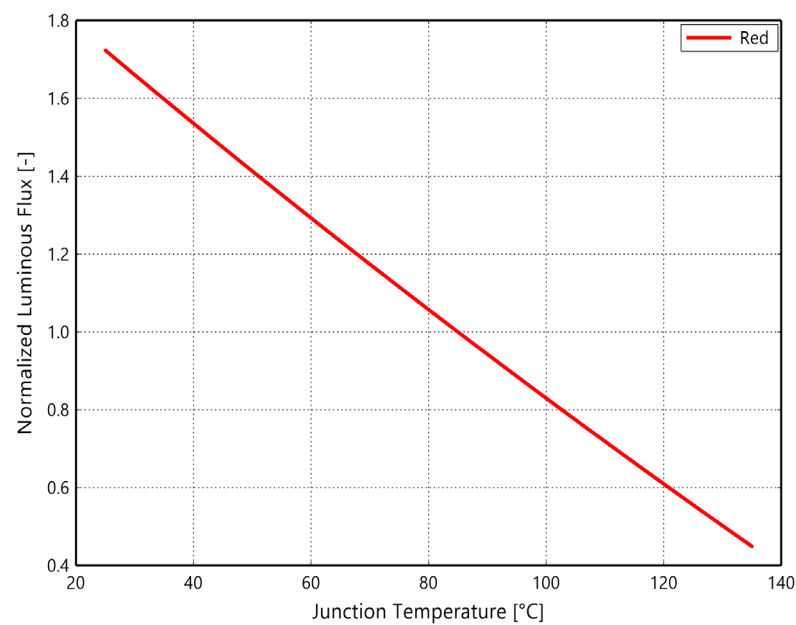


Figure 2b. Typical normalized luminous flux vs. junction temperature for LUXEON CZ ES Red at 1000mA

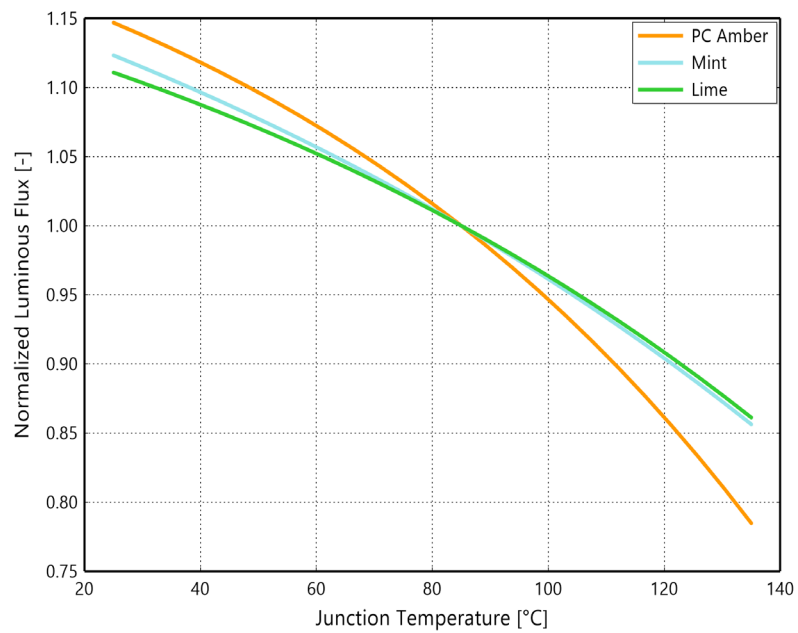


Figure 2c. Typical normalized luminous flux vs. junction temperature for LUXEON CZ ES PC Amber, Mint and Lime at 1000mA

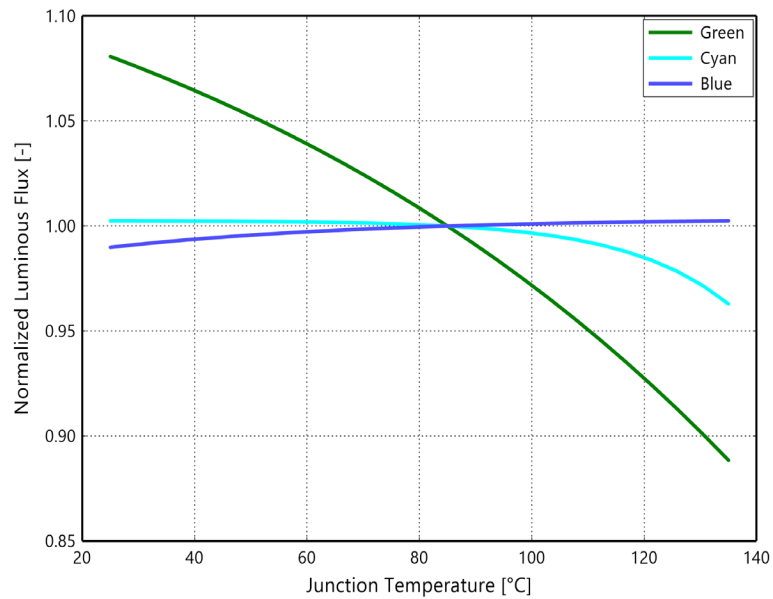


Figure 2d. Typical normalized luminous flux vs. junction temperature for LUXEON CZ ES Green, Cyan and Blue at 1000mA

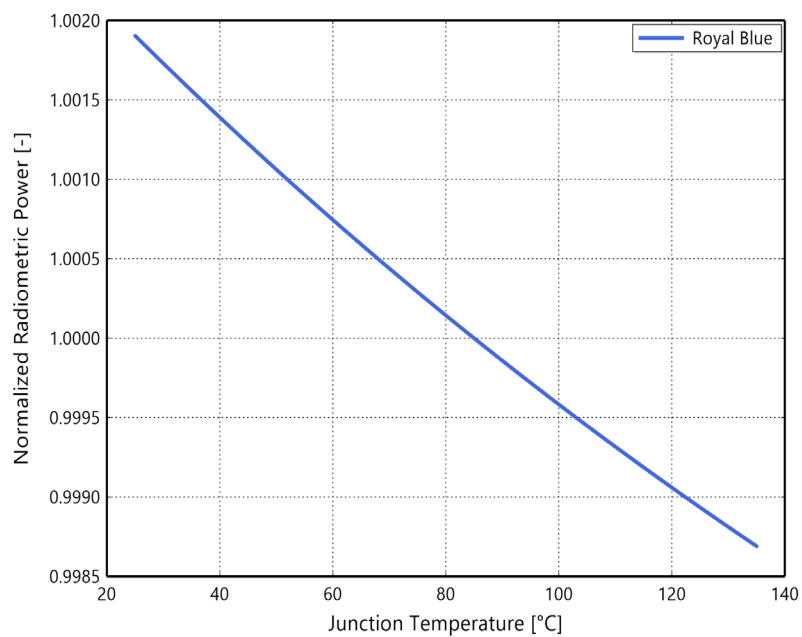


Figure 2e. Typical normalized radiometric power vs. junction temperature for LUXEON CZ ES Royal Blue at 1000mA

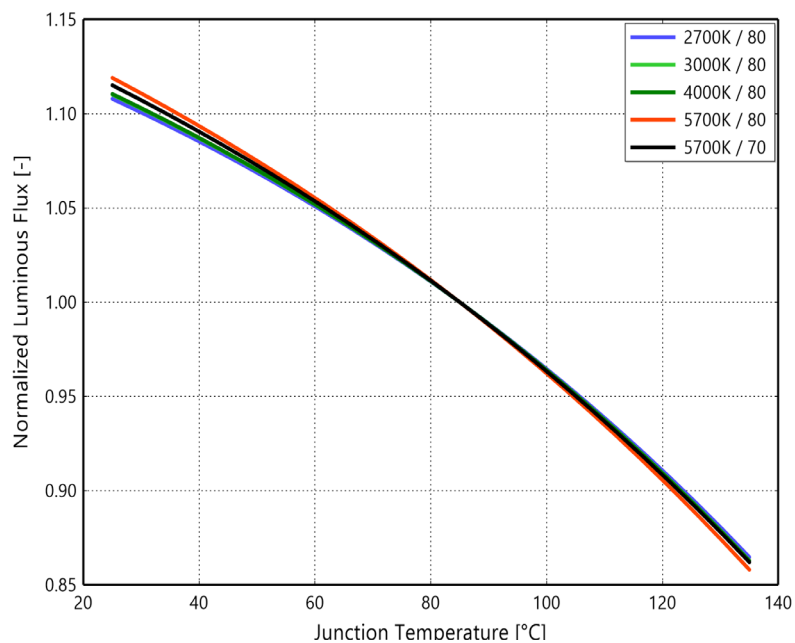


Figure 2f. Typical normalized luminous flux vs. junction temperature for LUXEON CZ ES White at 1000mA

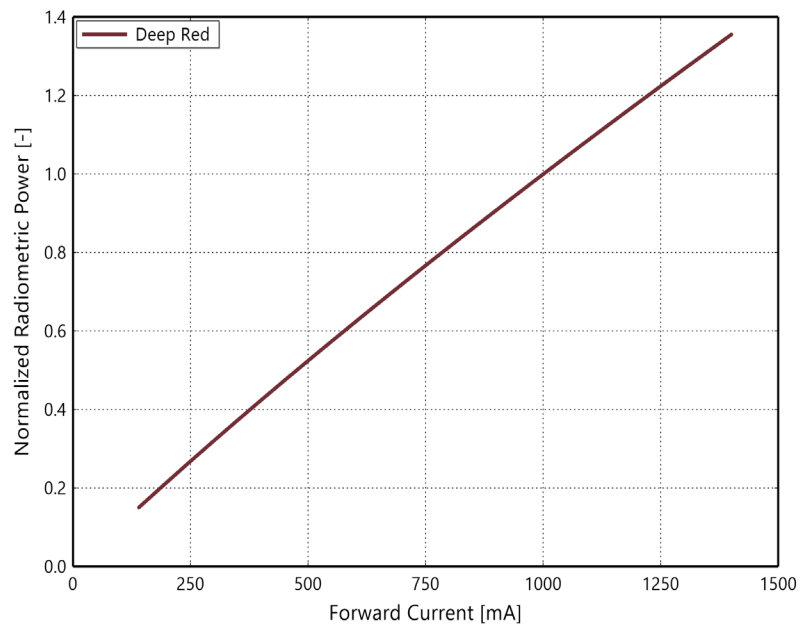


Figure 3a. Typical normalized radiometric power vs. forward current for LUXEON CZ ES Deep Red at  $T_j=85^{\circ}\text{C}$

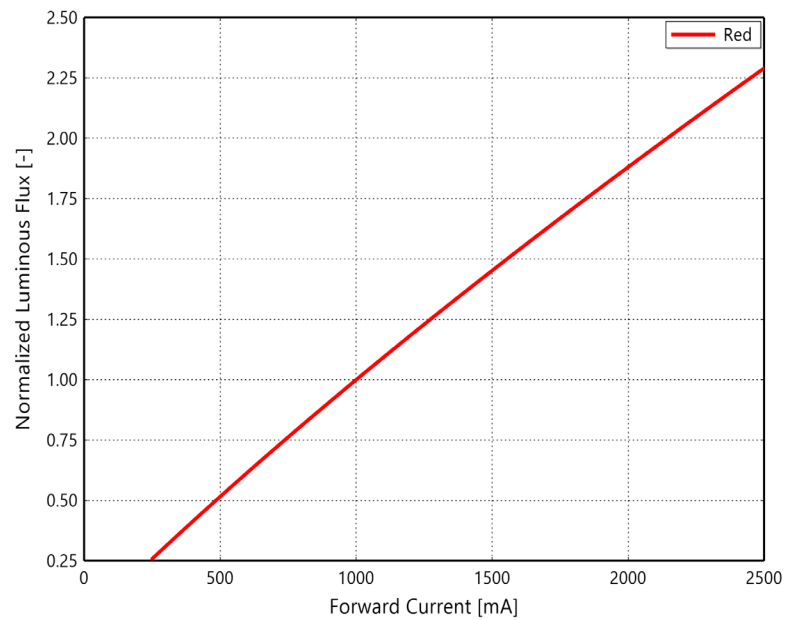


Figure 3b. Typical normalized luminous flux vs. forward current for LUXEON CZ ES Red at  $T_j=85^{\circ}\text{C}$

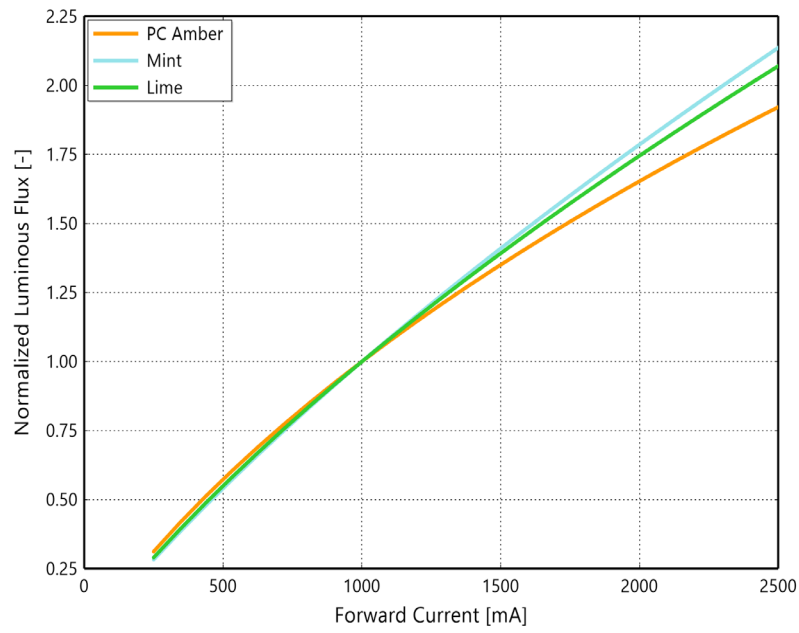


Figure 3c. Typical normalized luminous flux vs. forward current for LUXEON CZ ES PC Amber, Mint and Lime at  $T_j=85^{\circ}\text{C}$

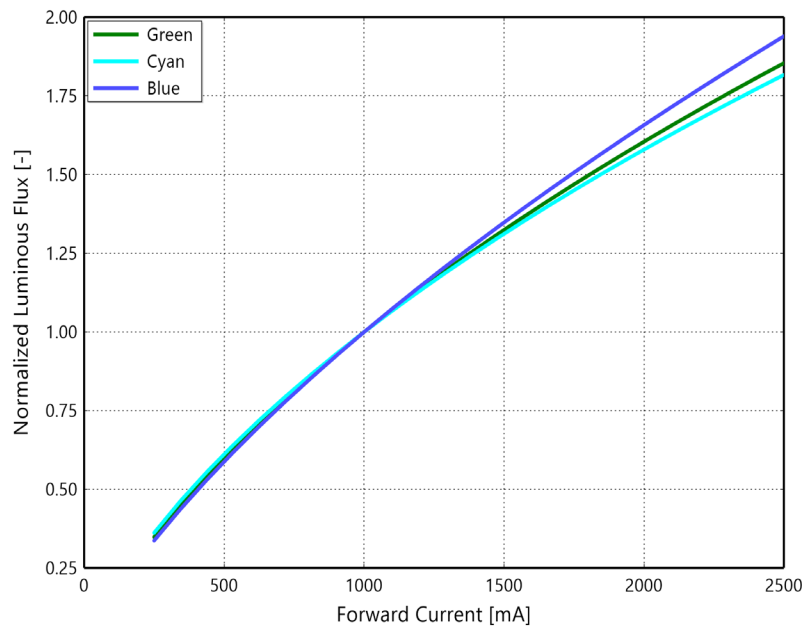


Figure 3d. Typical normalized luminous flux vs. forward current for LUXEON CZ ES Green, Cyan and Blue at  $T_j=85^{\circ}\text{C}$

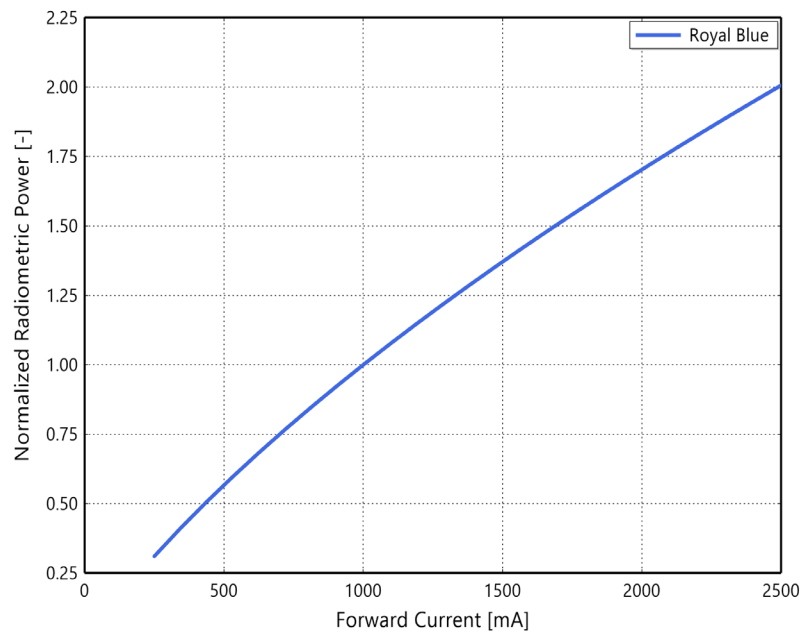


Figure 3e. Typical normalized radiometric power vs. forward current for LUXEON CZ ES Royal Blue at  $T_j=85^{\circ}\text{C}$

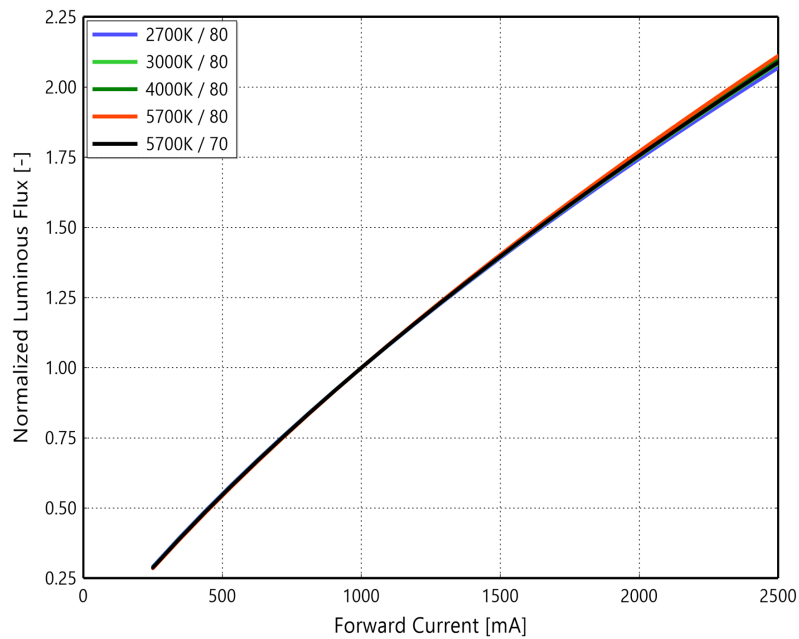


Figure 3f. Typical normalized luminous flux vs. forward current for LUXEON CZ ES White at  $T_j=85^{\circ}\text{C}$

# Forward Current Characteristics

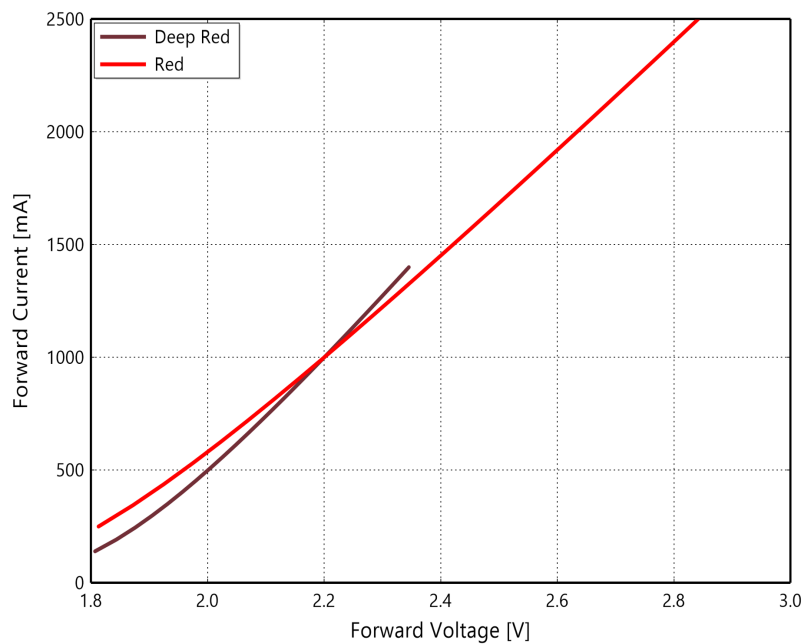


Figure 4a. Typical forward current vs. forward voltage for LUXEON CZ ES Deep Red and Red at  $T_j=85^{\circ}\text{C}$

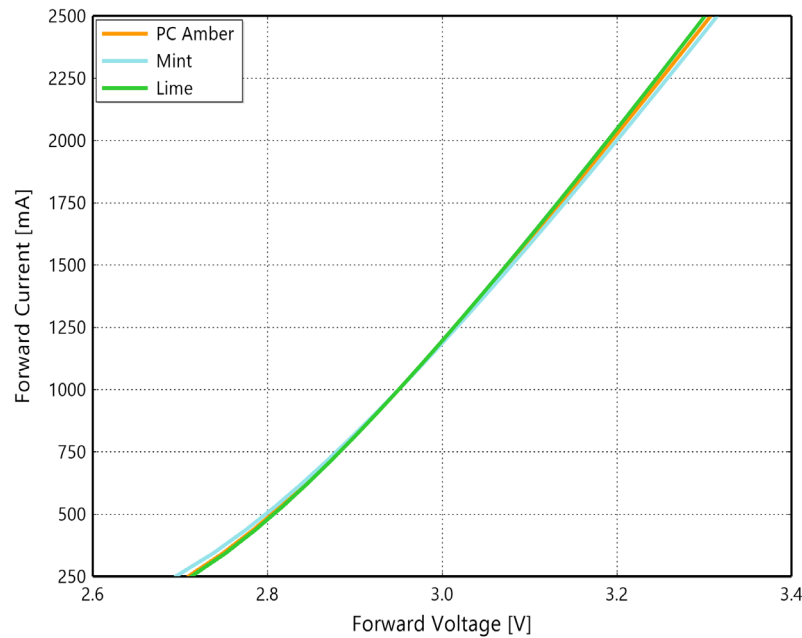


Figure 4b. Typical forward current vs. forward voltage for LUXEON CZ ES PC Amber, Mint and Lime at  $T_j=85^{\circ}\text{C}$

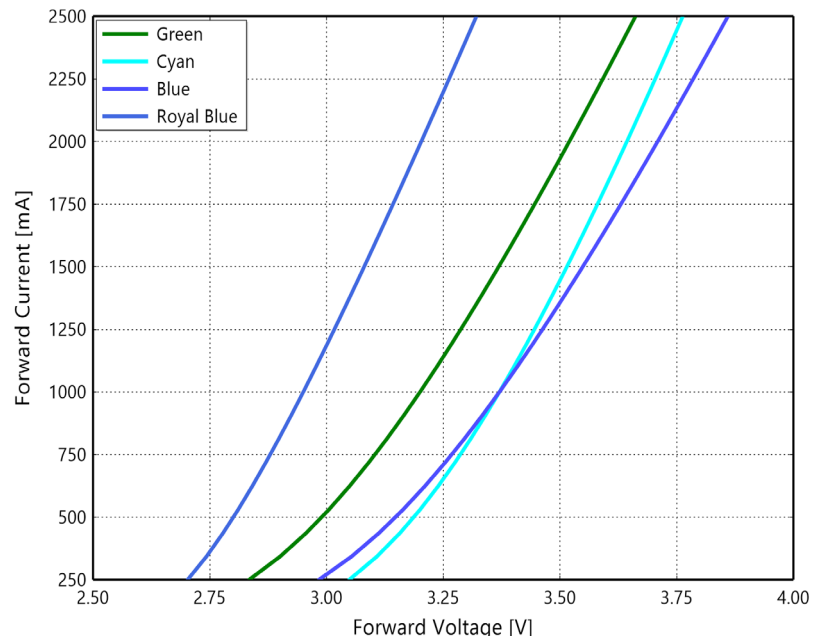


Figure 4c. Typical forward current vs. forward voltage for LUXEON CZ ES Green, Cyan, Blue and Royal Blue at  $T_j=85^{\circ}\text{C}$

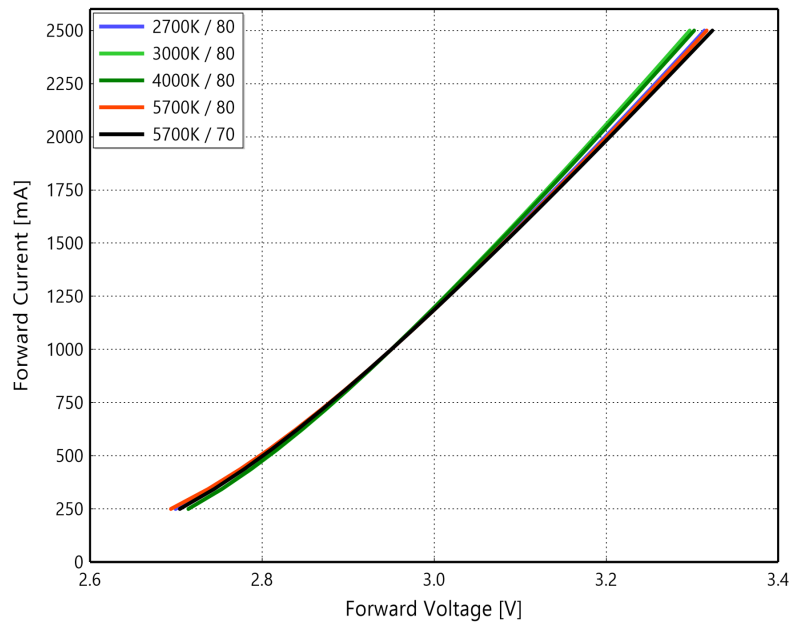


Figure 4d. Typical forward current vs. forward voltage for LUXEON CZ ES White at  $T_j=85^{\circ}\text{C}$

# Radiation Pattern Characteristics

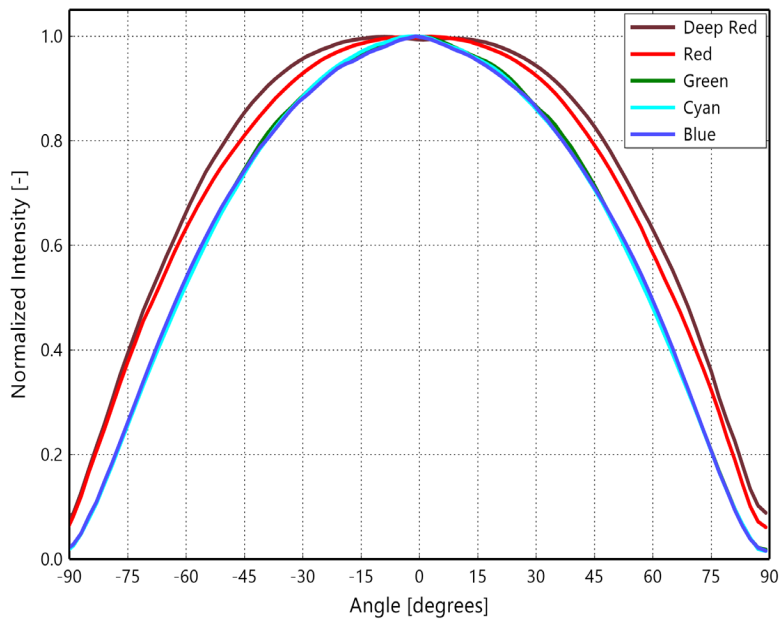


Figure 5a. Typical radiation pattern for LUXEON CZ ES Deep Red, Red, Green, Cyan and Blue at 1000mA,  $T_j=85^{\circ}\text{C}$

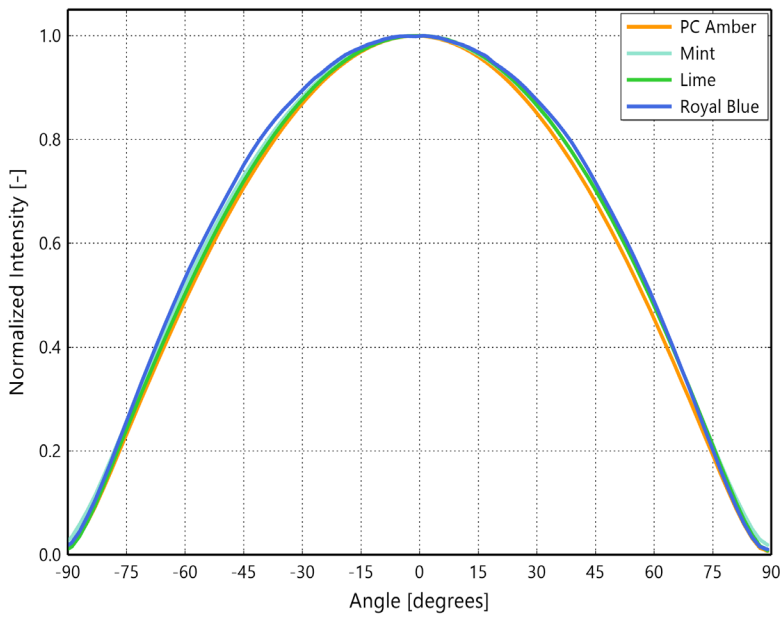


Figure 5b. Typical radiation pattern for LUXEON CZ ES PC Amber, Mint, Lime and Royal Blue at 1000mA,  $T_j=85^{\circ}\text{C}$

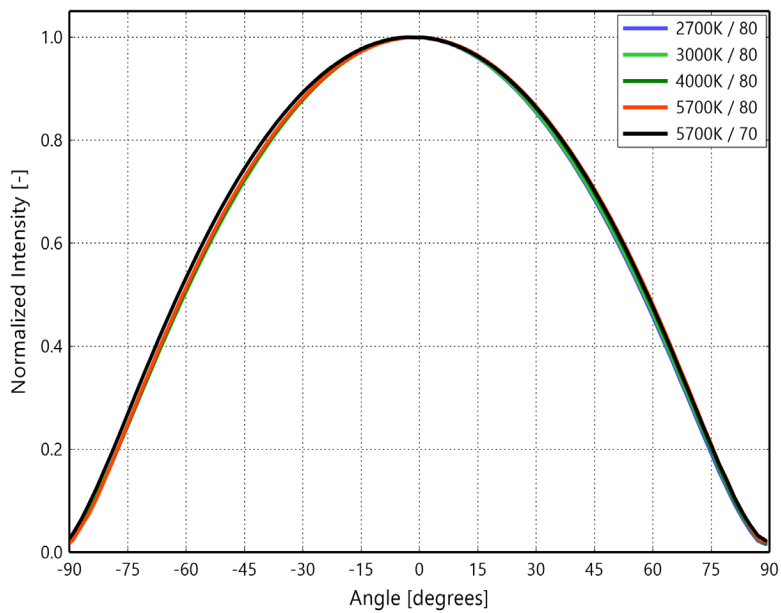


Figure 5c. Typical radiation pattern for LUXEON CZ ES White at 1000mA,  $T_j=85^{\circ}\text{C}$

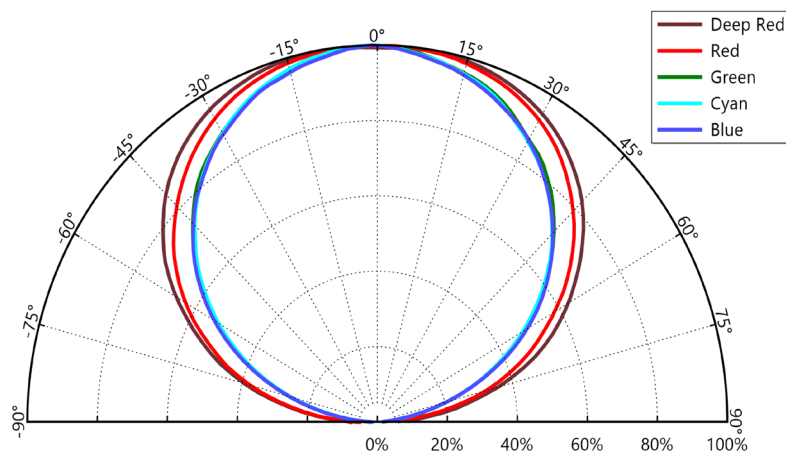


Figure 6a. Typical polar radiation pattern for LUXEON CZ ES Deep Red, Red, Green, Cyan and Blue at 1000mA,  $T_j=85^{\circ}\text{C}$

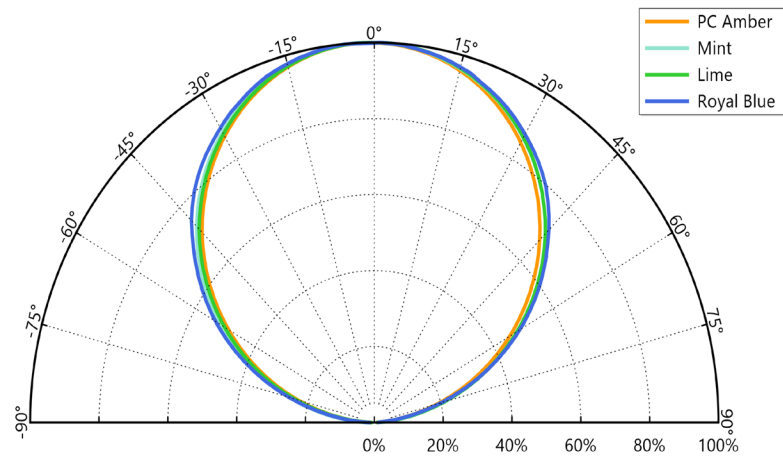


Figure 6b. Typical polar radiation pattern for LUXEON CZ ES PC Amber, Mint, Lime and Royal Blue at 1000mA,  $T_j=85^{\circ}\text{C}$

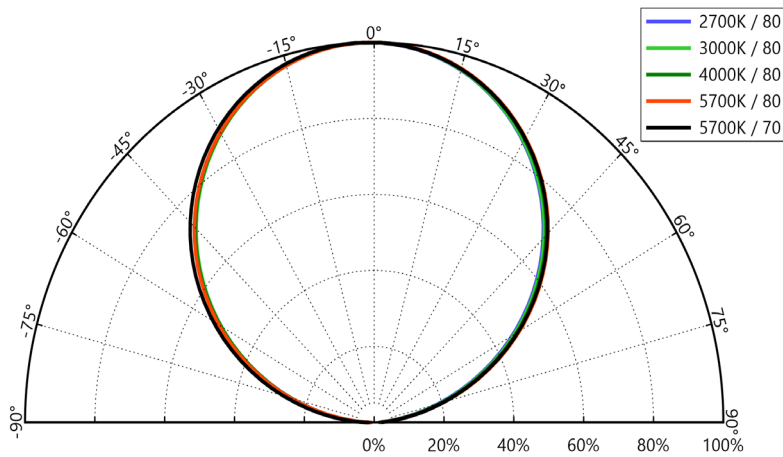


Figure 6c. Typical polar radiation pattern for LUXEON CZ ES White at 1000mA,  $T_j=85^{\circ}\text{C}$

# 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, radiometric power, color point, peak wavelength, dominant wavelength and forward voltage.

LUXEON CZ ES Color Line LEDs are labeled using a 4-digit alphanumeric CAT code following the format below:

**A B C D**

Where:

- A** – designates luminous flux bin or radiometric power bin (luminous flux bin example: A=90 to 95 lm, B= 95 to 100 lm; radiometric power bin example: Deep Red C=1040 to 1100mW, Royal Blue G=1320 to 1390mW)
- B C** – designates color bin, peak wavelength bin or dominant wavelength bin (peak wavelength bin example: Deep Red 10=655 to 665nm; dominant wavelength bin example: Red 40=624 to 634nm)
- D** – designates forward voltage bin (example: A=1.80 to 2.00V, B=2.00 to 2.20V)

Therefore, a LUXEON CZ ES Red LED with a lumen range of 110 to 115 lm, a dominant wavelength of 624 to 634nm and a forward voltage range of 2.20 to 2.40V has the following CAT code:

**E 4 0 C**

## Luminous Flux Bins

Table 5 lists the standard photometric luminous flux bins for LUXEON CZ ES Color Line 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 CZ ES Color Line**

| BIN | LUMINOUS FLUX <sup>[1]</sup> (lm) |         |
|-----|-----------------------------------|---------|
|     | MINIMUM                           | MAXIMUM |
| A   | 90                                | 95      |
| B   | 95                                | 100     |
| C   | 100                               | 105     |
| D   | 105                               | 110     |
| E   | 110                               | 115     |
| F   | 115                               | 120     |
| G   | 120                               | 130     |
| H   | 130                               | 140     |
| J   | 140                               | 150     |
| K   | 150                               | 160     |
| L   | 160                               | 180     |
| M   | 180                               | 200     |
| N   | 200                               | 220     |
| P   | 220                               | 240     |
| Q   | 240                               | 260     |
| R   | 260                               | 280     |
| S   | 280                               | 300     |
| T   | 300                               | 320     |
| U   | 320                               | 350     |
| V   | 350                               | 380     |
| W   | 380                               | 410     |
| X   | 410                               | 440     |
| Y   | 440                               | 480     |
| Z   | 480                               | 520     |
| 1   | 520                               | 560     |
| 2   | 560                               | 600     |

**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 LUXEON CZ ES Deep Red and Royal Blue

| COLOR      | BIN | RADIOMETRIC POWER <sup>(1)</sup> (mW) |         |
|------------|-----|---------------------------------------|---------|
|            |     | MINIMUM                               | MAXIMUM |
| Deep Red   | A   | 900                                   | 970     |
|            | B   | 970                                   | 1040    |
|            | C   | 1040                                  | 1110    |
|            | D   | 1110                                  | 1180    |
| Royal Blue | F   | 1230                                  | 1310    |
|            | G   | 1310                                  | 1390    |
|            | H   | 1390                                  | 1460    |
|            | J   | 1460                                  | 1530    |
|            | K   | 1530                                  | 1600    |
|            | L   | 1600                                  | 1670    |

Notes for Table 6:  
1. Lumileds maintains a tolerance of ±6.5% on radiometric power measurements.

# Color Bin Definitions

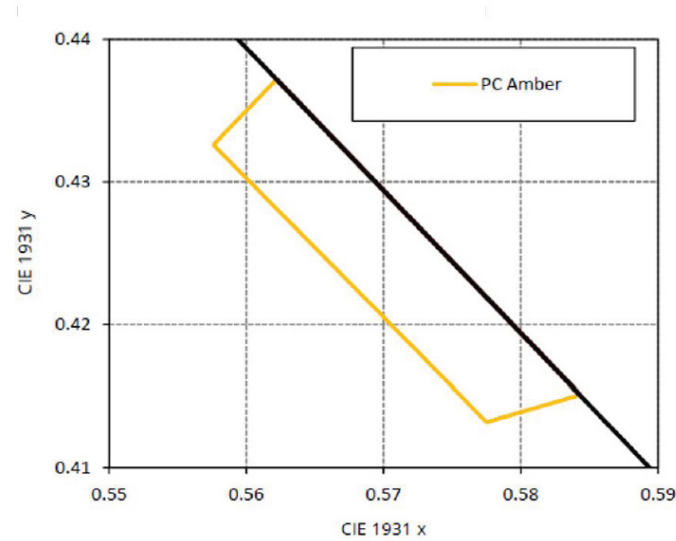


Figure 7. Color bin structure for LUXEON CZ ES PC Amber for Table 7

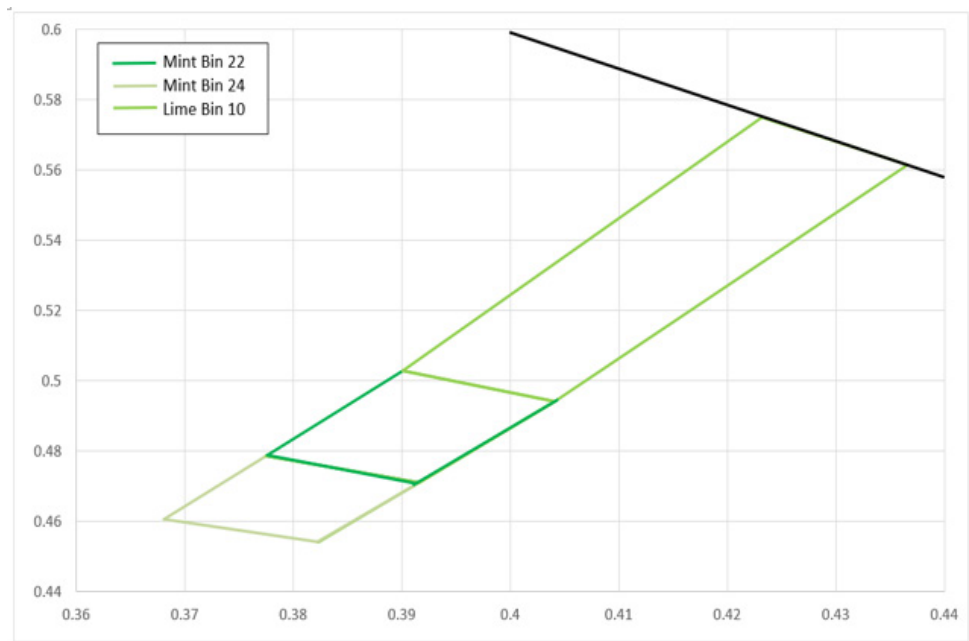


Figure 8. Color bin structure for LUXEON CZ ES Mint and Lime for Table 7

Table 7. Color bin definitions for LUXEON CZ ES PC Amber, Mint and Lime

| COLOR    | PART NUMBER        | BIN | x      | y      |
|----------|--------------------|-----|--------|--------|
| PC Amber | L1CV-PCA1000000000 | 20  | 0.5622 | 0.4372 |
|          |                    |     | 0.5576 | 0.4326 |
|          |                    |     | 0.5775 | 0.4132 |
|          |                    |     | 0.5843 | 0.4151 |
| Mint     | L1CV-MNT1000000000 | 22  | 0.4041 | 0.4941 |
|          |                    |     | 0.3901 | 0.5030 |
|          |                    |     | 0.3775 | 0.4787 |
|          |                    | 24  | 0.3916 | 0.4711 |
|          |                    |     | 0.3916 | 0.4711 |
|          |                    |     | 0.3775 | 0.4787 |
| Lime     | L1CV-LME1000000000 | 10  | 0.3681 | 0.4606 |
|          |                    |     | 0.3823 | 0.4540 |
|          |                    |     | 0.3901 | 0.5030 |
|          |                    |     | 0.4232 | 0.5749 |
|          |                    |     | 0.4366 | 0.5616 |
|          |                    |     | 0.4041 | 0.4941 |

Notes for Table 7:  
1. Lumileds maintains a tolerance of  $\pm 0.005$  on x and y color coordinates measurements.

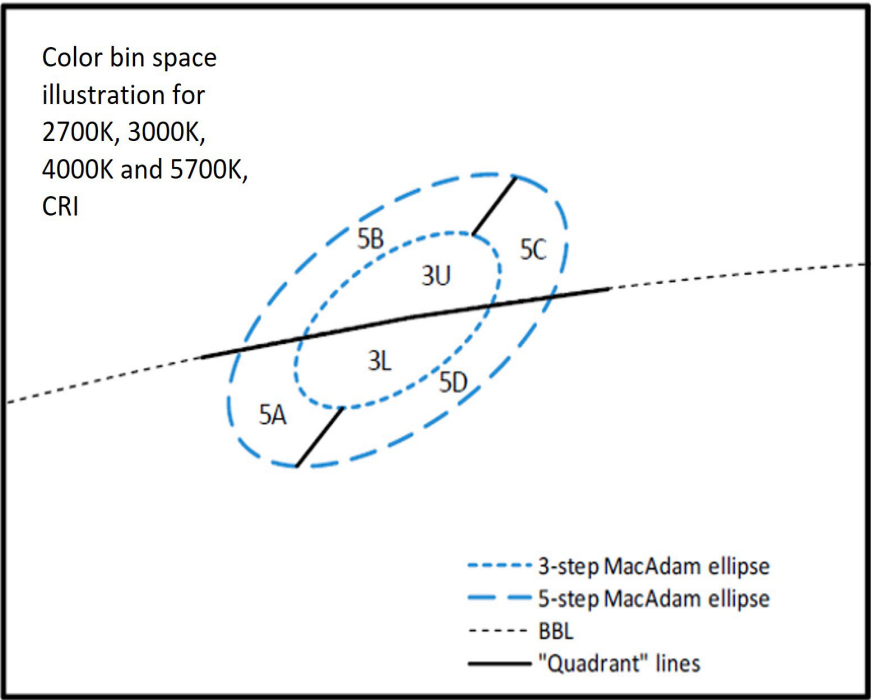


Figure 9. Color bin structure for LUXEON CZ ES Color Line

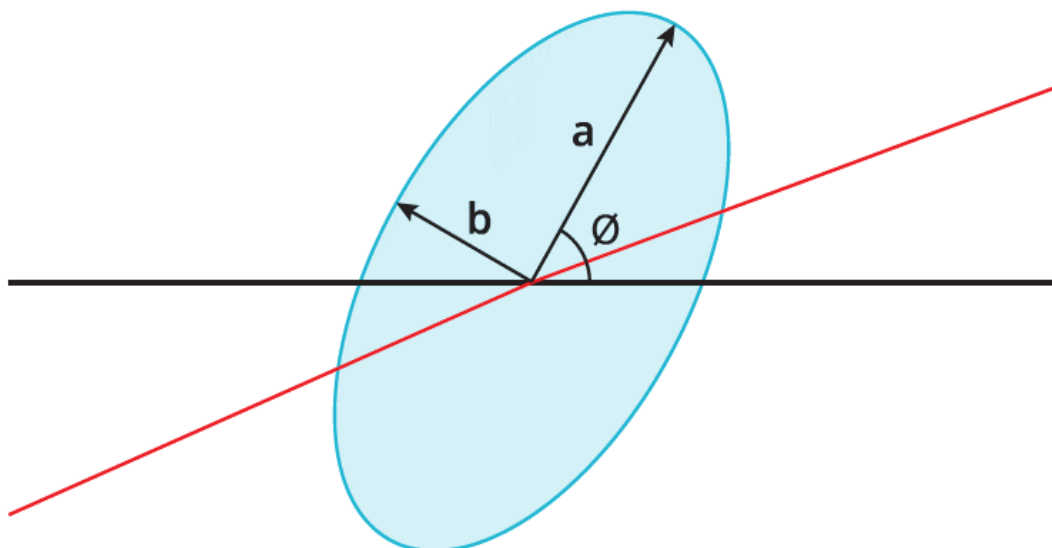


Figure 10. 3- and 5-step MacAdam ellipse illustration for Tables 8a and 8b

Table 8a. 3- and 5-step MacAdam ellipse color bin definitions for LUXEON CZ ES White at 1000mA,  $T_j = 85^\circ\text{C}$

| NOMINAL CCT | COLOR SPACE                   | CENTER POINT<br>(cx, cy) | MAJOR AXIS,<br>a | MINOR AXIS,<br>b | ELLIPSE<br>ROTATION<br>ANGLE, $\theta$ |
|-------------|-------------------------------|--------------------------|------------------|------------------|----------------------------------------|
| 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°                                  |
| 4000K       | Single 3-step MacAdam ellipse | (0.3818, 0.3797)         | 0.00939          | 0.00402          | 53.7°                                  |
| 5700K       | Single 3-step MacAdam ellipse | (0.3287, 0.3417)         | 0.00746          | 0.00320          | 59.1°                                  |
| 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°                                  |
| 4000K       | Single 5-step MacAdam ellipse | (0.3818, 0.3797)         | 0.01565          | 0.00670          | 53.7°                                  |
| 5700K       | Single 5-step MacAdam ellipse | (0.3287, 0.3417)         | 0.01243          | 0.00533          | 59.1°                                  |

Notes for Table 8a:

1. Lumileds maintains a tolerance of  $\pm 0.005$  on x and y coordinates in the CIE 1931 color space.

Table 8b. MacAdam ellipse color bin definitions for LUXEON CZ ES Color Line

| NOMINAL CCT | SDCM                                                            |
|-------------|-----------------------------------------------------------------|
| 30          | Single 3-step MacAdam ellipse (CCTs 5000K and above)            |
| 3U          | Single 3-step MacAdam ellipse (80 CRI and CCTs 4000K and below) |
| 3L          | Single 3-step MacAdam ellipse (80 CRI and CCTs 4000K and below) |
| 50          | Single 5-step MacAdam ellipse (70CRI)                           |
| 5A          | Single 5-step MacAdam ellipse (80CRI)                           |
| 5B          | Single 5-step MacAdam ellipse (80CRI)                           |
| 5C          | Single 5-step MacAdam ellipse (80CRI)                           |
| 5D          | Single 5-step MacAdam ellipse (80CRI)                           |

## Peak Wavelength Bins

Table 9. Peak wavelength bin definitions for LUXEON CZ ES Deep Red and Royal Blue

| COLOR      | PART NUMBER        | BIN | PEAK WAVELENGTH <sup>(1)</sup> (nm) |         |
|------------|--------------------|-----|-------------------------------------|---------|
|            |                    |     | MINIMUM                             | MAXIMUM |
| Deep Red   | L1CV-DRD1000000000 | 10  | 655                                 | 665     |
|            |                    | 20  | 665                                 | 675     |
| Royal Blue | L1CV-RYL1000000000 | 30  | 440                                 | 445     |
|            |                    | 40  | 445                                 | 450     |
|            |                    | 50  | 450                                 | 455     |
|            |                    | 60  | 455                                 | 460     |

Notes for Table 9:

1. Lumileds maintains a tolerance of  $\pm 2.0$ nm on peak wavelength measurements.

## Dominant Wavelength Bins

Table 10. Dominant wavelength bin definitions for LUXEON CZ ES Red, Green, Cyan and Blue at 1000mA, T<sub>J</sub>=85°C

| COLOR | PART NUMBER        | BIN | DOMINANT WAVELENGTH <sup>(1)</sup> (nm) |         |
|-------|--------------------|-----|-----------------------------------------|---------|
|       |                    |     | MINIMUM                                 | MAXIMUM |
| Red   | L1CV-RED1000000000 | 40  | 624.0                                   | 634.0   |
| Green | L1CV-GRN1000000000 | 10  | 520.0                                   | 525.0   |
|       |                    | 20  | 525.0                                   | 530.0   |
|       |                    | 30  | 530.0                                   | 535.0   |
|       |                    | 40  | 535.0                                   | 540.0   |
| Cyan  | L1CV-CYN1000000000 | 10  | 490.0                                   | 496.0   |
|       |                    | 20  | 496.0                                   | 500.0   |
|       |                    | 30  | 500.0                                   | 505.0   |
|       |                    | 40  | 505.0                                   | 510.0   |
| Blue  | L1CV-BLU1000000000 | 10  | 460.0                                   | 465.0   |
|       |                    | 20  | 465.0                                   | 470.0   |
|       |                    | 30  | 470.0                                   | 475.0   |
|       |                    | 40  | 475.0                                   | 480.0   |
|       |                    | 50  | 480.0                                   | 485.0   |

Notes for Table 10:

1. Lumileds maintains a tolerance of  $\pm 0.5$ nm on dominant wavelength measurements.

# Forward Voltage Bins

Table 11. Forward voltage bin definitions for LUXEON CZ ES Color Line

| BIN | FORWARD VOLTAGE <sup>(1)</sup> (V <sub>f</sub> ) |         |
|-----|--------------------------------------------------|---------|
|     | MINIMUM                                          | MAXIMUM |
| A   | 1.80                                             | 2.00    |
| B   | 2.00                                             | 2.20    |
| C   | 2.20                                             | 2.40    |
| D   | 2.40                                             | 2.60    |
| E   | 2.60                                             | 2.80    |
| F   | 2.80                                             | 3.00    |
| G   | 3.00                                             | 3.20    |
| H   | 3.20                                             | 3.40    |
| J   | 3.40                                             | 3.60    |

Notes for Table 11:  
1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.

# Mechanical Dimensions

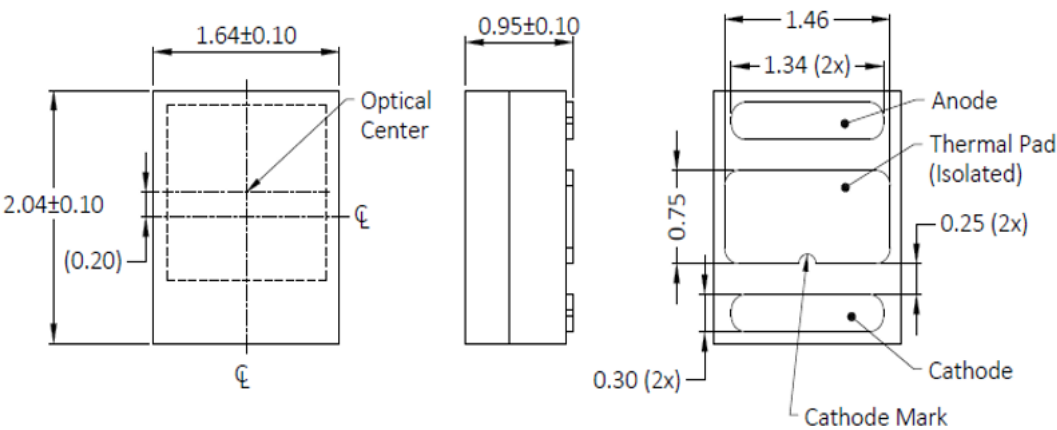


Figure 11. Mechanical dimensions for LUXEON CZ ES Red and Deep Red

Notes for Figure 11:  
1. Drawings are not to scale.  
2. All dimensions are in millimeters.

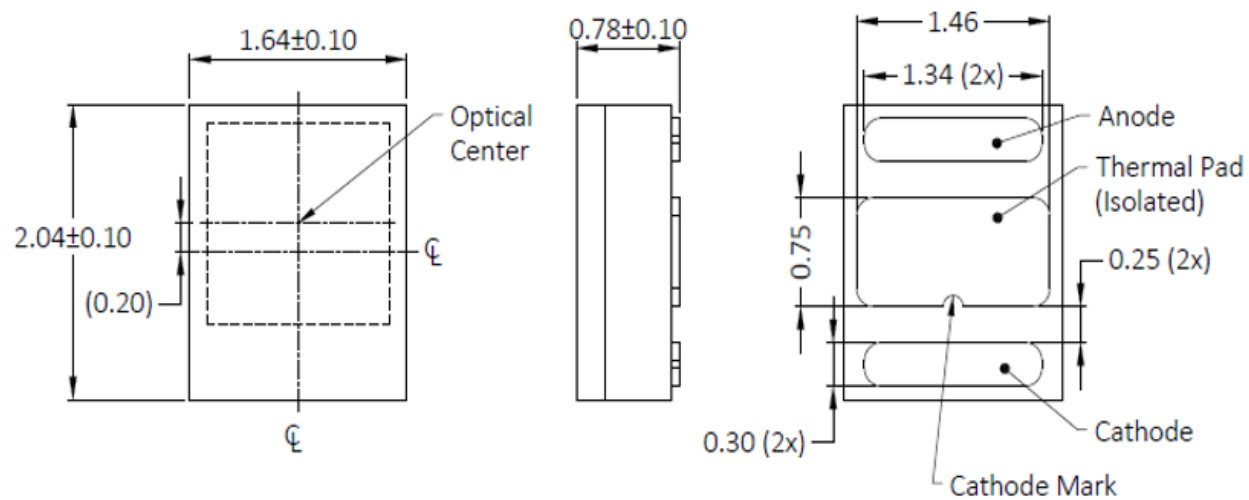


Figure 12. Mechanical dimensions for LUXEON CZ ES all other colors

Notes for Figure 12:

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

# Reflow Soldering Guidelines

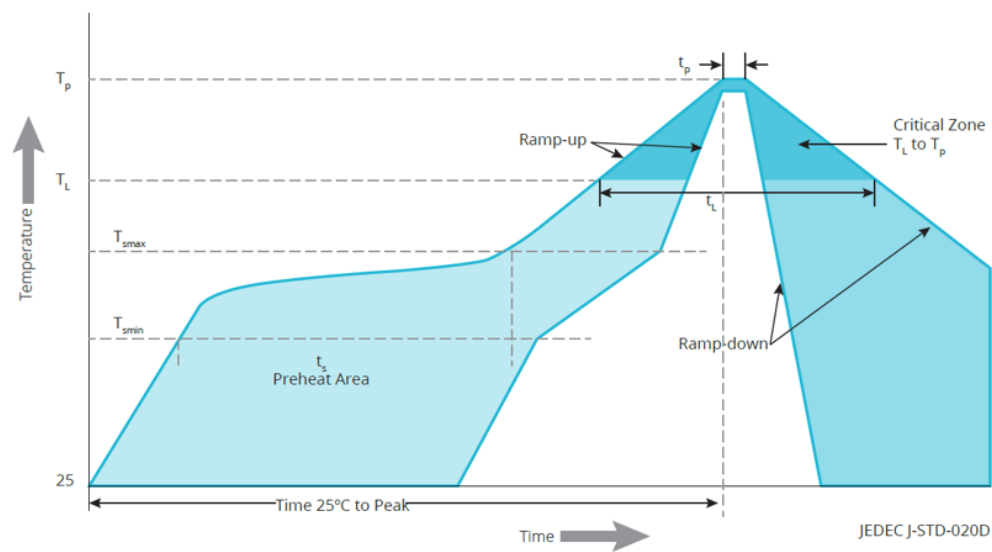


Figure 13. Visualization of the acceptable reflow temperature profile as specified in Table 12

Table 12. Reflow profile characteristics for LUXEON CZ ES Color Line

| 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 ( $T_L$ to $T_p$ )                   | 3°C / second maximum |
| Liquidus Temperature ( $T_L$ )                    | 217°C                |
| Time Maintained Above Temperature $T_L$ ( $t_L$ ) | 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 ( $T_p$ to $T_L$ )                 | 6°C / second maximum |
| Time 25°C to Peak Temperature                     | 8 minutes maximum    |

## JEDEC Moisture Sensitivity

Table 13. Moisture sensitivity levels for LUXEON CZ ES Color Line

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

## Solder Pad Design

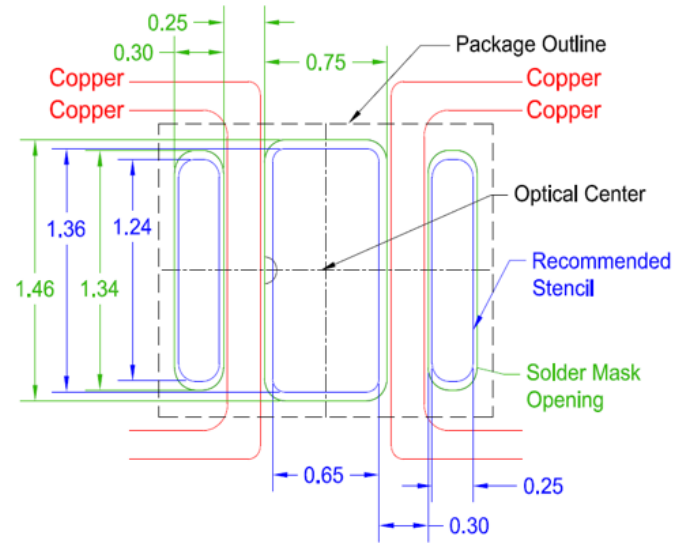


Figure 14. Recommended PCB solder pad layout for LUXEON CZ ES Color Line

### Notes for Figure 14:

1. Drawings are not to scale.
2. All dimensions are in millimeters.
3. The drawing above shows the recommended solder pad layout on Printed Circuit Board (PCB).

## Packaging Information

### Pocket Tape Dimensions

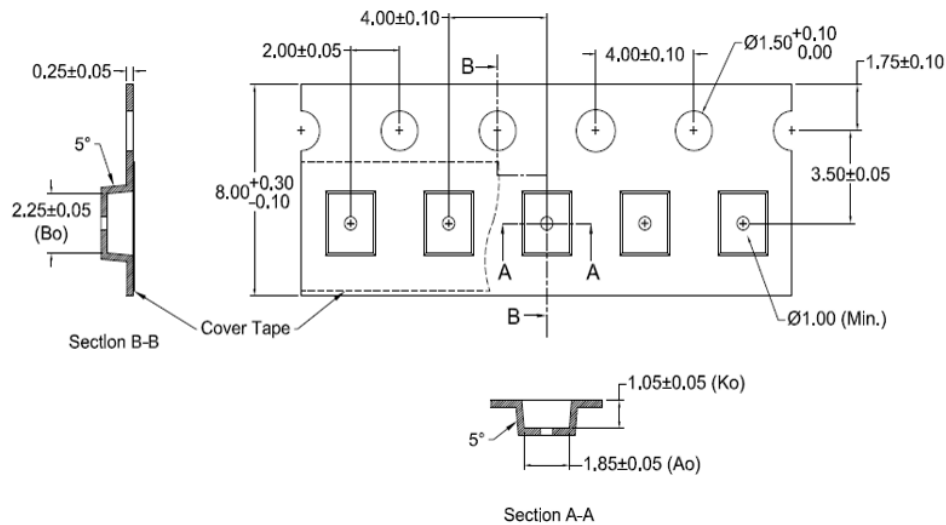


Figure 15. Pocket Tape dimensions for LUXEON CZ ES Color Line

### Notes for Figure 15:

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

## Reel Dimensions

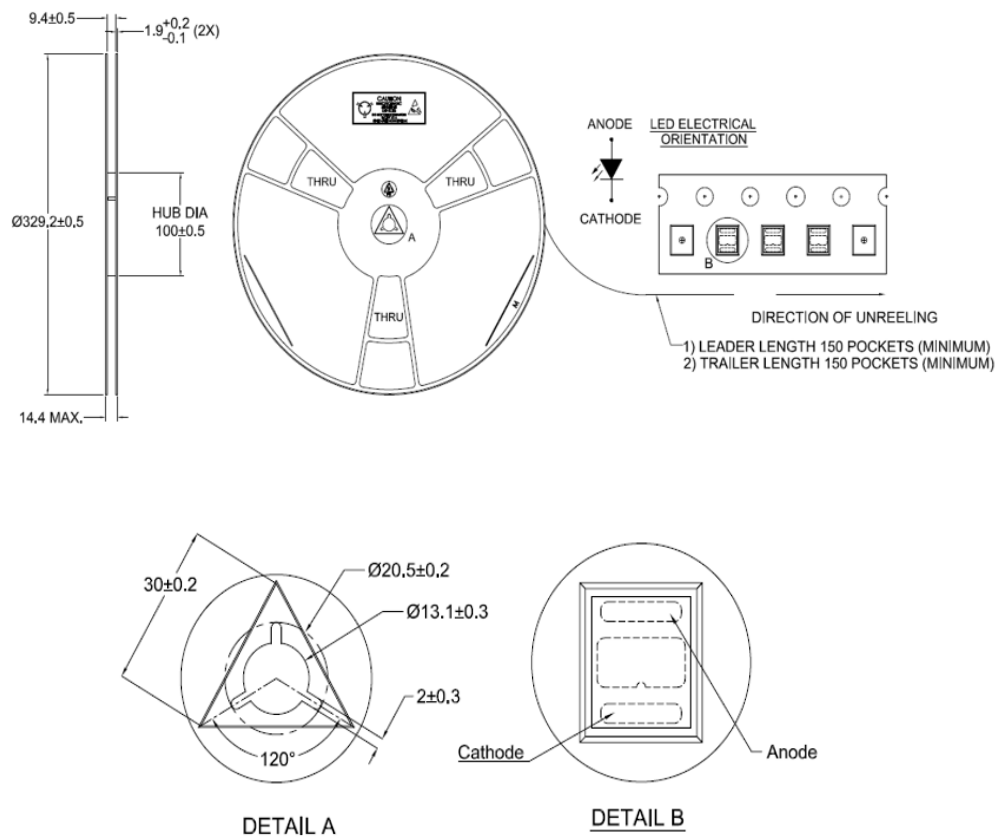


Figure 16. Reel dimensions for LUXEON CZ ES Color Line

**Notes for Figure 16:**

1. Drawings are not to scale.
2. All dimensions are in millimeters.
3. Maximum 1,000 pieces per reel.

## About Lumileds

Lumileds is a global leader in LED and microLED technology, innovation, and solutions for the automotive, display, illumination, mobile, and other markets where light sources are essential. Our approximately 3,500 employees operate in over 15 countries and partner with our customers to deliver never before possible solutions for lighting, safety, and well-being.

To learn more about our lighting solutions, visit [lumileds.com](https://lumileds.com).



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