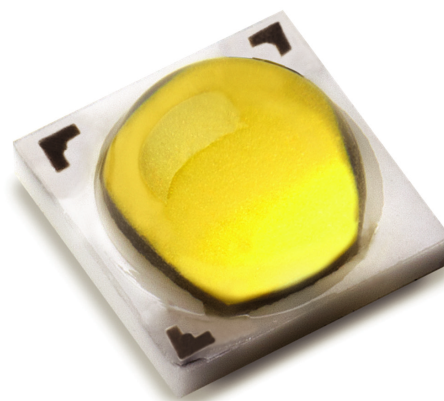


# LUXEON T

High-Efficacy, Illumination  
Grade LED light source



## Introduction

LUXEON® T emitters are illumination grade LEDs designed to deliver high efficacy with high flux density to enable tight beam control in directional and high-lumen applications. With *Freedom from Binning™* and leading performance, LUXEON T emitters allow system optimization to achieve the highest possible efficacy and the flexibility to reduce the number of emitters, all without compromising on high color rendering across the full Correlated Color Temperature (CCT) range from 2700K to 5000K. With tight CCT control, LUXEON T ensures consistency in system color point.

### LUXEON T

- Superior efficacy and light output from a compact source
- Optimized for efficacy driven applications with typical  $V_f$ : 2.7V and low thermal resistance: 3 K/W
- Delivers high luminance ideal for directional lighting
- Specified, targeted and tested hot, at real world operating temperatures,  $T_j = 85^\circ\text{C}$  to ensure in-application performance
- *Freedom from Binning* delivers color consistency within 3 or 5-step SDCM MacAdam Ellipse
- Proven reliability
- Exceeds ENERGY STAR lumen maintenance requirements
- UL-recognized component [E3525 I9] with level 4 enclosure consideration

### Key Applications

- Lamps
- Downlights
- Indoor
- High bay & Low bay
- Outdoor
- Architectural

**PHILIPS**  
LUMILEDS

# Table of Contents

|  |    |
|--|----|
| General Information .....  | 2  |
| Product Nomenclature .....   | 2  |
| Lumen Maintenance .....  | 2  |
| Environmental Compliance .....                                     | 2  |
| Product Selection Guide .....                                      | 3  |
| Optical Characteristics .....                                      | 4  |
| Electrical Characteristics .....                                   | 5  |
| Absolute Maximum Ratings .....                                     | 5  |
| JEDEC Moisture Sensitivity .....                                   | 6  |
| Reflow Soldering Characteristics .....                             | 6  |
| Mechanical Dimensions .....  | 7  |
| Solder Pad Design .....  | 8  |
| Relative Spectral Distribution vs.Wavelength Characteristics ..... | 9  |
| Typical Light Output Characteristics .....                         | 10 |
| Typical Forward Current Characteristics .....                      | 11 |
| Emitter Pocket Tape Packaging .....                                | 12 |
| Emitter Reel Packaging .....                                       | 13 |
| Product Binning and Labeling .....                                 | 14 |
| Luminous Flux and Forward Voltage Bins .....                       | 14 |
| Radiometric Power Bins .....                                       | 15 |
| LUXEON T 3-step and 5-step MacAdam Ellipse Color Definition .....  | 16 |

# General Information

## Product Nomenclature

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

The part number designation is explained as follows:

L X H c - FW x x - Y and L X H c - FW x x - A B C D

Where:

c – designates minimum CRI performance (7 for 70 CRI, 8 for 80 CRI, 9 for 90 CRI, I for Royal Blue)

xx – designates nominal ANSI CCT (27 for 2700K, 30 for 3000K, RB for Royal Blue)

Y – 3 designates 3 SDCM and 5 designates 5 SDCM

ABCD – minimum flux output/ radiometric power (mW)

Therefore, 3-Step 80 CRI products tested and binned at 2700K will have the following part number:

L X H 8 – FW 2 7 - 3

Therefore, 1000 mW Royal Blue products will have the following part number:

LXHI - FWRB - 1000

## Lumen Maintenance

LUXEON T 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 T is 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 T: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

# Product Selection Guide

## Product Selection Guide for LUXEON T Emitters, Junction Temperature = 85°C

**Table 1.**

| Typical Performance Characteristics at 350 mA, 700 mA, and 1000 mA for LUXEON T, Junction Temperature = 85°C |                  |        |                        |                            |        |         |   |        |         |                         |        |         |
|--|------------------|--------|------------------------|----------------------------|--------|---------|---|--------|---------|-------------------------|--------|---------|
| Part Number  | Nominal ANSI CCT | CRI    | Luminous Flux (lm) Min | Typical Luminous Flux (lm) |        |         | Typical Forward Voltage (V <sub>f</sub> ) |        |         | Typical Efficacy (lm/W) |        |         |
|  |                  | 700 mA | 700 mA                 | 350 mA                     | 700 mA | 1000 mA | 350 mA                                    | 700 mA | 1000 mA | 350 mA                  | 700 mA | 1000 mA |
| LXH7-FW30  | 3000K            | 70 min | 200                    | 117                        | 218    | 298     | 2.71                                      | 2.80   | 2.86    | 123                     | 111    | 104     |
| LXH7-FW40  | 4000K            | 70 min | 210                    | 133                        | 249    | 340     | 2.71                                      | 2.80   | 2.86    | 140                     | 127    | 119     |
| LXH7-FW50  | 5000K            | 70 min | 220                    | 136                        | 255    | 348     | 2.71                                      | 2.80   | 2.86    | 143                     | 130    | 122     |
| LXH7-FW57  | 5700K            | 70 min | 220                    | 136                        | 255    | 348     | 2.71                                      | 2.80   | 2.86    | 143                     | 130    | 122     |
| LXH7-FW65  | 6500K            | 70 min | 220                    | 136                        | 255    | 348     | 2.71                                      | 2.80   | 2.86    | 143                     | 130    | 122     |
| LXH8-FW27-Y  | 2700K            | 80 min | 170                    | 100                        | 186    | 254     | 2.71                                      | 2.80   | 2.86    | 105                     | 95     | 89      |
| LXH8-FW30-Y  | 3000K            | 80 min | 180                    | 106                        | 197    | 269     | 2.71                                      | 2.80   | 2.86    | 112                     | 101    | 94      |
| LXH8-FW35-Y  | 3500K            | 80 min | 190                    | 112                        | 208    | 278     | 2.71                                      | 2.80   | 2.86    | 118                     | 106    | 97      |
| LXH8-FW40-Y  | 4000K            | 80 min | 190                    | 114                        | 212    | 288     | 2.71                                      | 2.80   | 2.86    | 120                     | 108    | 101     |
| LXH8-FW50-Y  | 5000K            | 80 min | 190                    | 120                        | 222    | 300     | 2.71                                      | 2.80   | 2.86    | 127                     | 113    | 105     |
| LXH9-FW30-Y  | 3000K            | 95 typ | 130                    | 86                         | 160    | 216     | 2.71                                      | 2.80   | 2.86    | 91                      | 82     | 76      |

Notes for Table 1:

1. Philips Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux and  $\pm 2$  on CRI measurements.

## Product Selection Guide for LUXEON T 3V Royal Blue, Junction Temperature = 85°C

**Table 2.**

| Performance at Test Current |             |                                |                                |                              |
|-----------------------------|-------------|--------------------------------|--------------------------------|------------------------------|
| Color                       | Part Number | Minimum Radiometric Power (mW) | Typical Radiometric Power (mW) | Typical Radiant Efficacy (%) |
| Royal Blue                  | LXHI - FWRB | 950                            | 1040                           | 53%                          |

Note for Table 2:

1. Philips Lumileds maintains a tolerance of  $\pm 6.5\%$  on flux measurements.
2. Test current is 700 mA for LXRO-SR00 products.

# Optical Characteristics

## LUXEON T at Test Current<sup>1</sup>, Junction Temperature = 85°C

**Table 3.**

| Nominal ANSI CCT | Part Number                             | 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            | LXH8-FW27-Y                             | 2725K                         | 160  | 120  |
| 3000K            | LXH7-FW30<br>LXH8-FW30-Y<br>LXH9-FW30-Y | 3045K                         | 160  | 120  |
| 3500K            | LXH8-FW35-Y                             | 3465K                         | 160  | 120  |
| 4000K            | LXH7-FW40<br>LXH8-FW40-Y                | 3985K                         | 160  | 120  |
| 5000K            | LXH7-FW50<br>LXH8-FW50-Y                | 5028K                         | 160  | 120  |
| 5700K            | LXH7-FW57                               | 5665K                         | 160  | 120  |
| 6500K            | LXH7-FW65                               | 6530K                         | 160  | 120  |

**Notes for Table 3:**

1. Test current is 700 mA D.C. for all LXHc-FWxx emitters.
2. Total angle at which 90% of total luminous flux is captured.
3. 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 700 mA for LUXEON T Junction Temperature = 85°C

**Table 4.**

| Nominal ANSI CCT | Forward Voltage V <sub>f</sub> <sup>1</sup><br>(V) |      | Typical Temperature<br>Coefficient of Forward Voltage <sup>2</sup><br>(mV/°C)<br>DV <sub>F</sub> / DT <sub>J</sub> | Typical Thermal Resistance<br>Junction to Thermal Pad (°C/W)<br>R <sub>u J-C</sub> |
|------------------|--|------|--|--|
|                  | 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  |
| Royal Blue       | 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<sub>J</sub> = 25°C and T<sub>J</sub> = 110°C at I<sub>F</sub> = 700 mA.

## Absolute Maximum Ratings

**Table 5.**

| Parameter                                       | LUXEON T  |
|---|---|
| DC Forward Current (mA) <sup>1,2</sup>          | 1050  |
| Peak Pulsed Forward Current (mA) <sup>1,3</sup> | 1200  |
| ESD Sensitivity                                 | < 8000V Human Body Model (HBM) Class 3A JESD22-A114-E       |
| LED Junction Temperature <sup>1</sup>           | 150°C   |
| Operating Case Temperature at 700 mA            | -40°C - 135°C   |
| Storage Temperature                             | -40°C - 135°C   |
| Soldering Temperature                           | JEDEC 020c 260°C  |
| Allowable Reflow Cycles                         | 3   |
| Reverse Voltage (Vr) <sup>5,6</sup>             | LUXEON T LEDs are not designed to be driven in reverse bias |

**Notes for Table 5:**

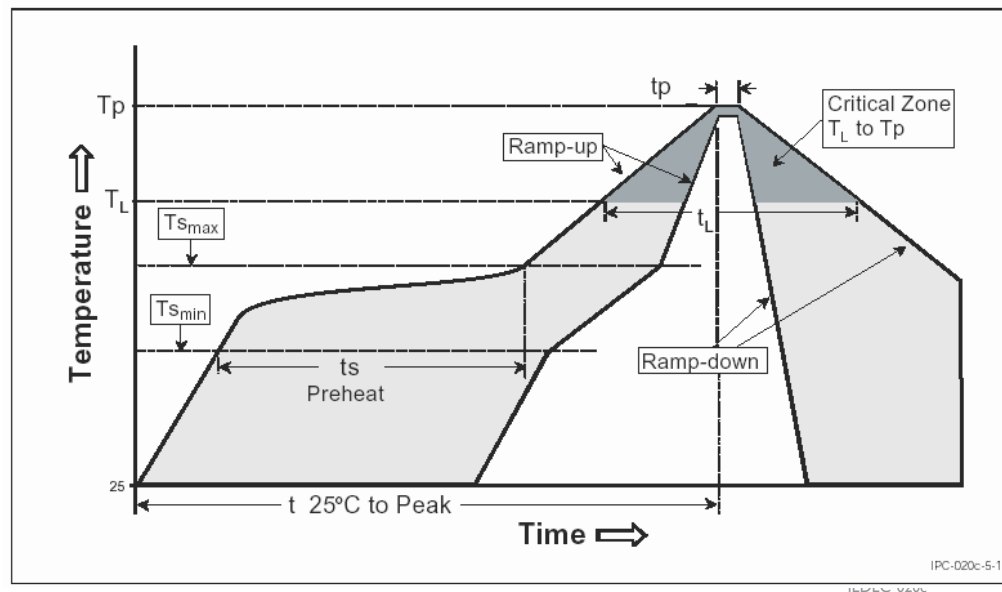
1. Proper current derating must be observed to maintain junction temperature below the maximum.  
For additional information on thermal measurement guidelines please refer to Application Brief AB106.
2. Residual periodic variations due to power conversion from alternating current (AC) to direct current (DC), also called "ripple", with frequencies
3. ≥ 100 Hz and amplitude ≤ 200 mA are acceptable, assuming the average current throughout each cycle does not exceed 1000 mA.
4. Pulsed operation with a peak drive current of 1200 mA is acceptable if the pulse on-time is ≤ 5 ms per cycle and the duty cycle is ≤ 50%
5. 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 200μA.
6. 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  | [ 30°C / 85% RH | 168h<br>+ 5 / - 0          | 85°C / 85% RH |

## Reflow Soldering Characteristics

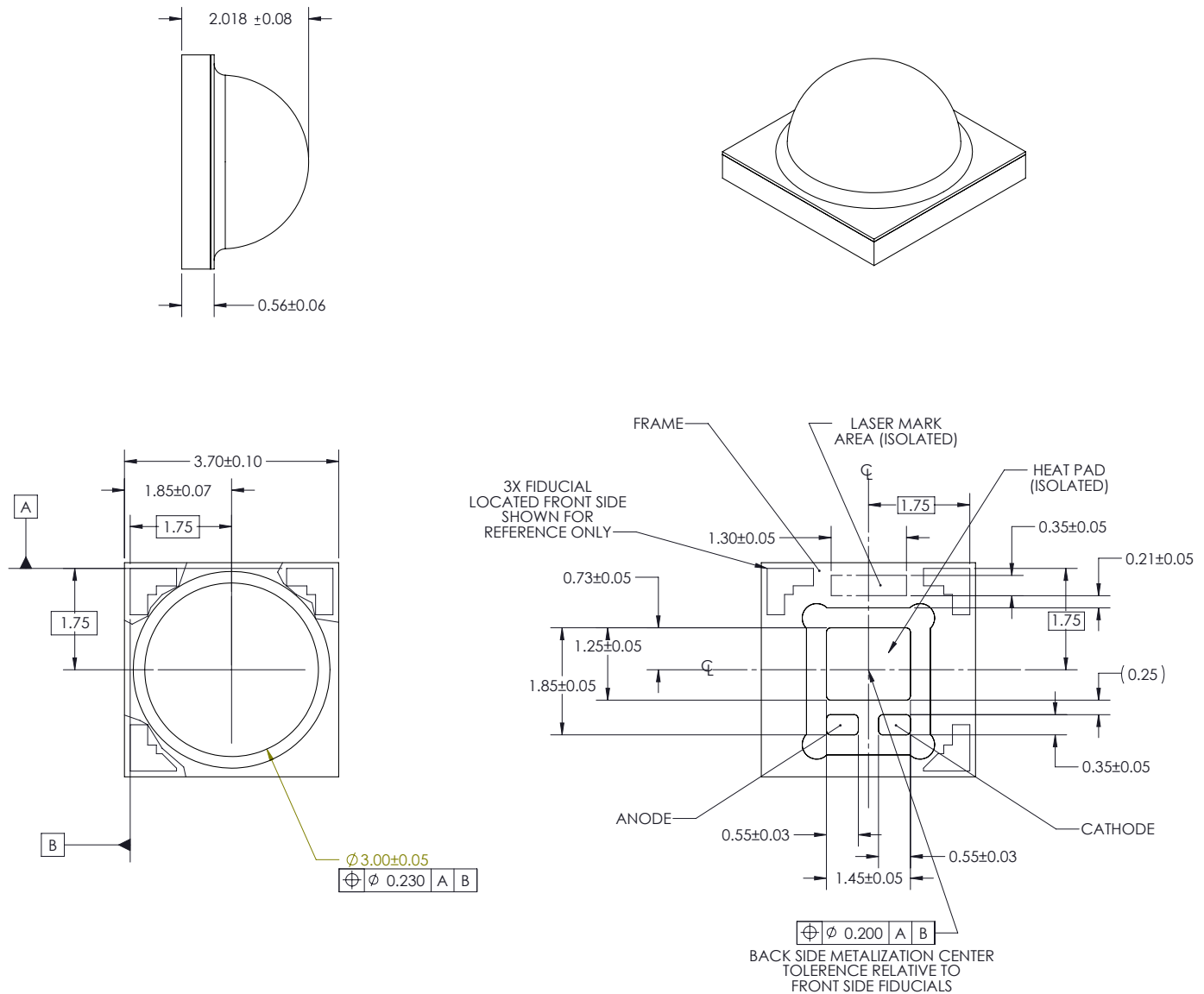


**Figure 1. Temperature profile for Table 7.**

**Table 7.**

| 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   |
| Time Maintained Above Temperature $T_L$              | 217°C              |
| Time Maintained Above Time ( $t_L$ )                 | 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      |

## Mechanical Dimensions



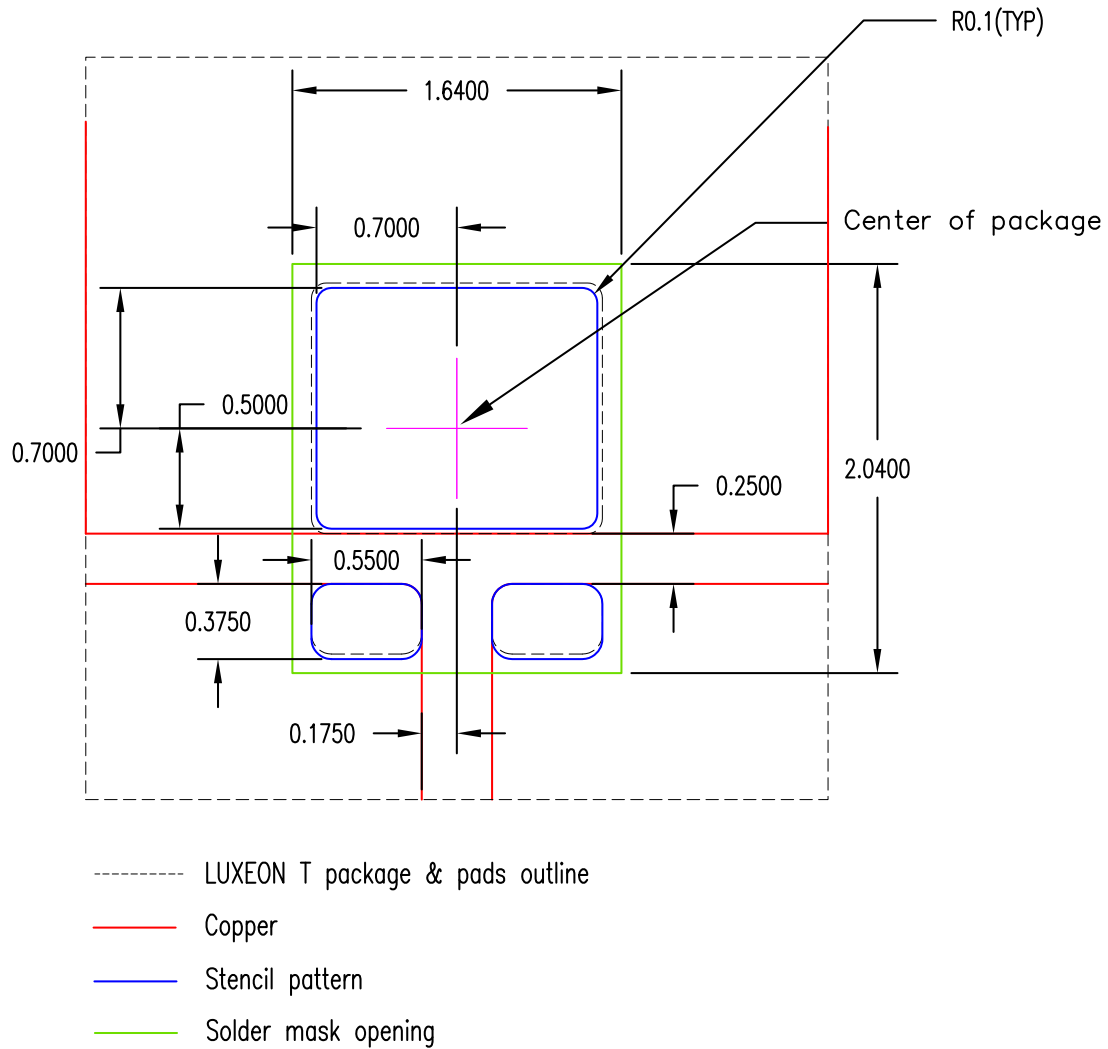
**Figure 2.**

### 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. Solder pad layout.**

### Notes for Figure 3:

1. The photograph shows the recommended LUXEON T layout on Printed Circuit Board (PCB).
2. For more information on assembly and layout, please refer to Application Brief 110 (AB110).
3. The .dwg files are available at [www.philipslumileds.com](http://www.philipslumileds.com) and [www.philipslumileds.cn.com](http://www.philipslumileds.cn.com).

# Relative Spectral Distribution vs. Wavelength Characteristics

LXHc-FWxx (White) at Test Current, Junction Temperature = 85°C

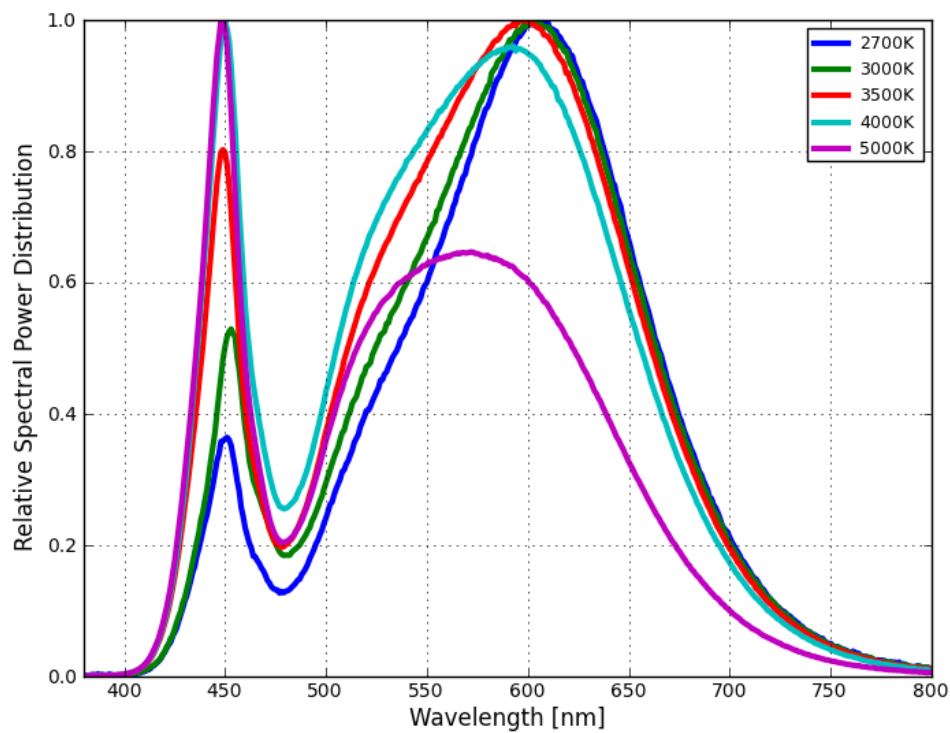


Figure 4. Color Spectrum of LXHc-FWxx.

LXHI-FWRB (Royal Blue) at Test Current, Junction Temperature = 85°C

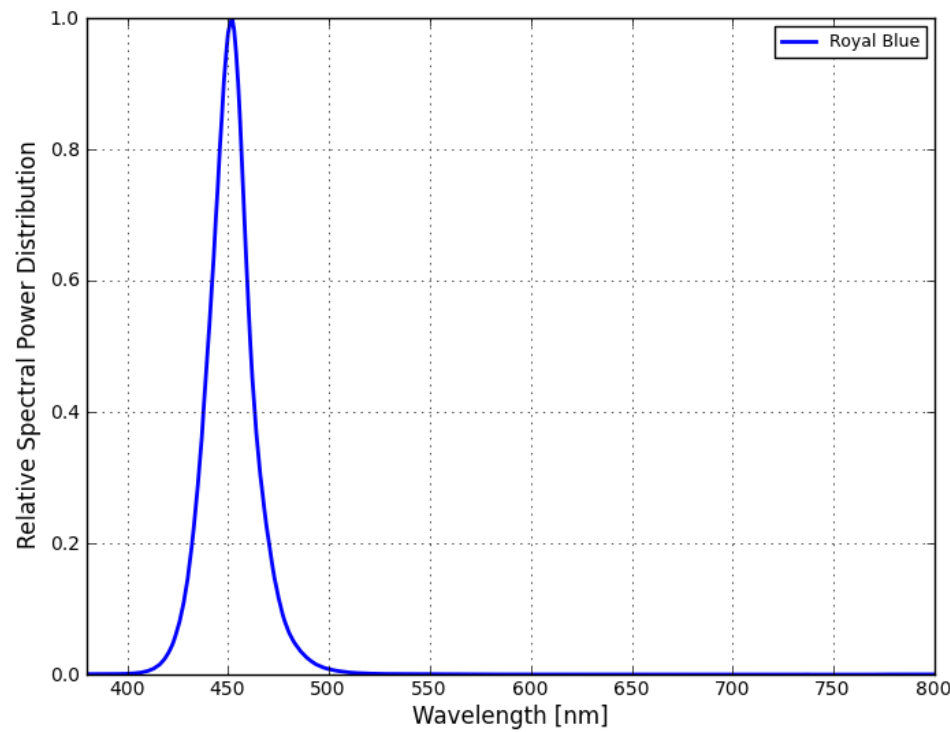


Figure 5. Color Spectrum of LXHI-FWRB.

## Typical Light Output Characteristics

Relative Light Output vs. Junction Temperature for LXHc-FWxx (White and Royal Blue),  
Test Current = 700 mA

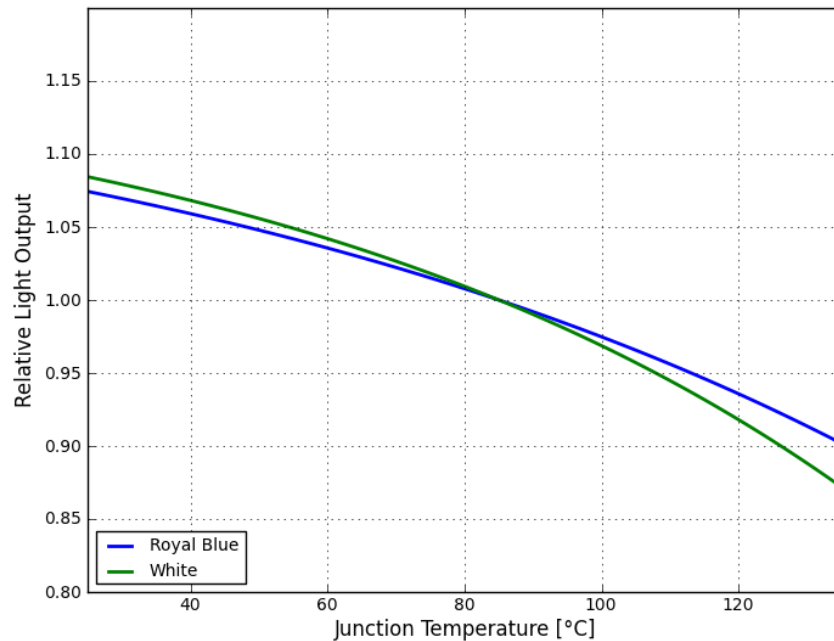


Figure 6. Relative light output vs. junction temperature, LXHc-FWxx.

Relative Light Output vs. Forward Current for LXHc-FWxx (White and Royal Blue),  
Junction Temperature = 85°C

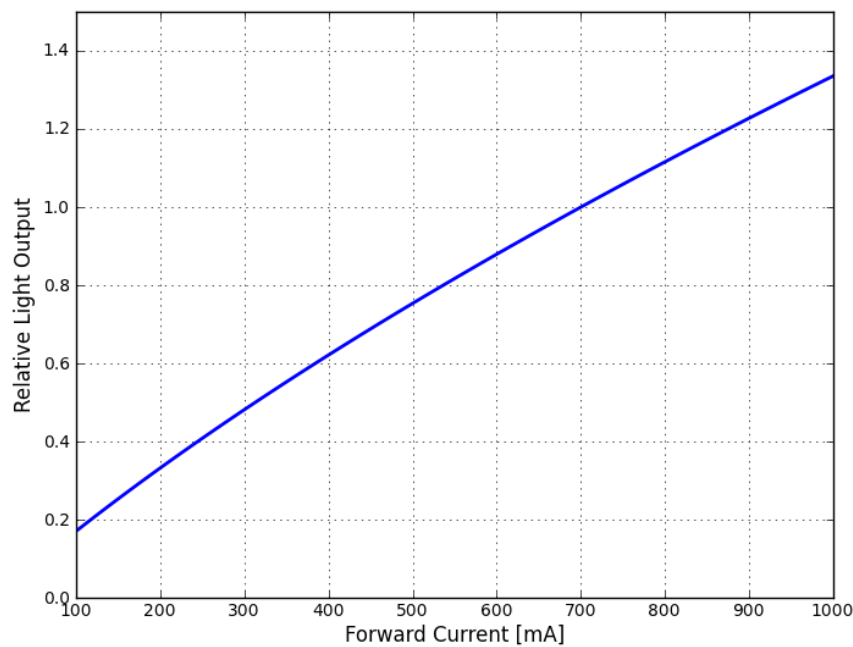
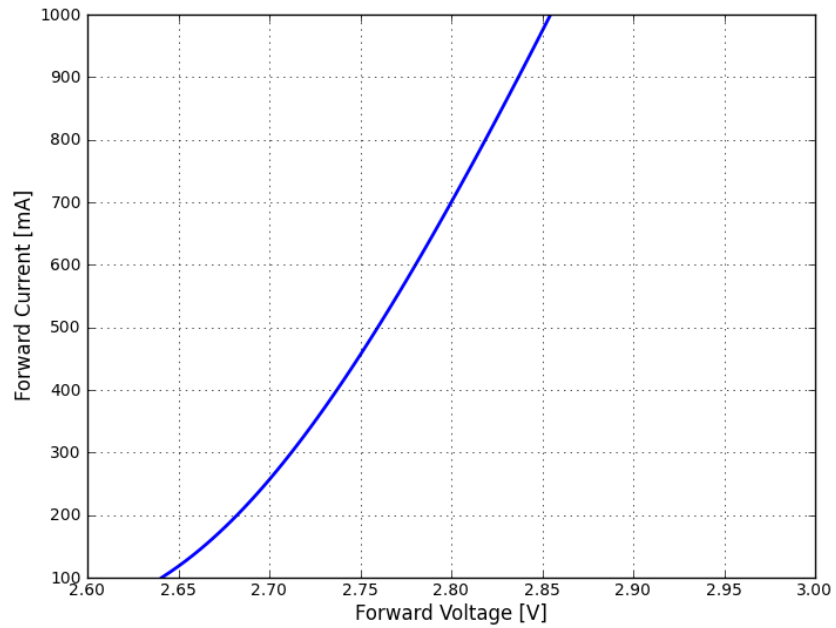


Figure 7. Typical relative luminous flux vs. forward current, LXHc-FWxx.

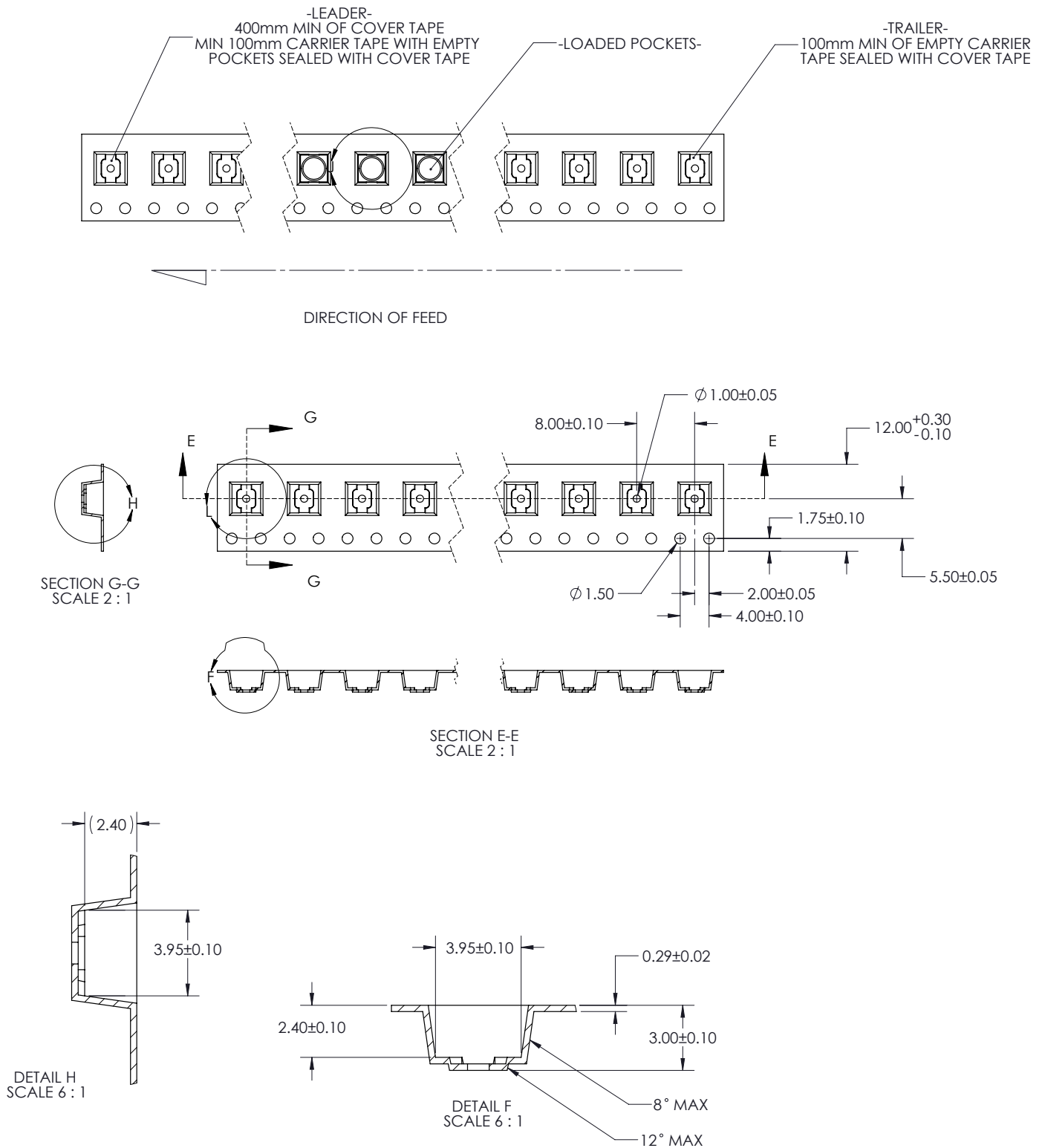
## Typical Forward Current Characteristics

Forward Current vs. Forward Voltage for LXHc-FWxx (White and Royal Blue),  
Junction Temperature = 85°C



**Figure 8. Typical forward current vs. forward voltage, LXHc-FWxx.**

# Emitter Pocket Tape Packaging



**Figure 9. Emitter pocket tape packaging.**

# Emitter Reel Packaging

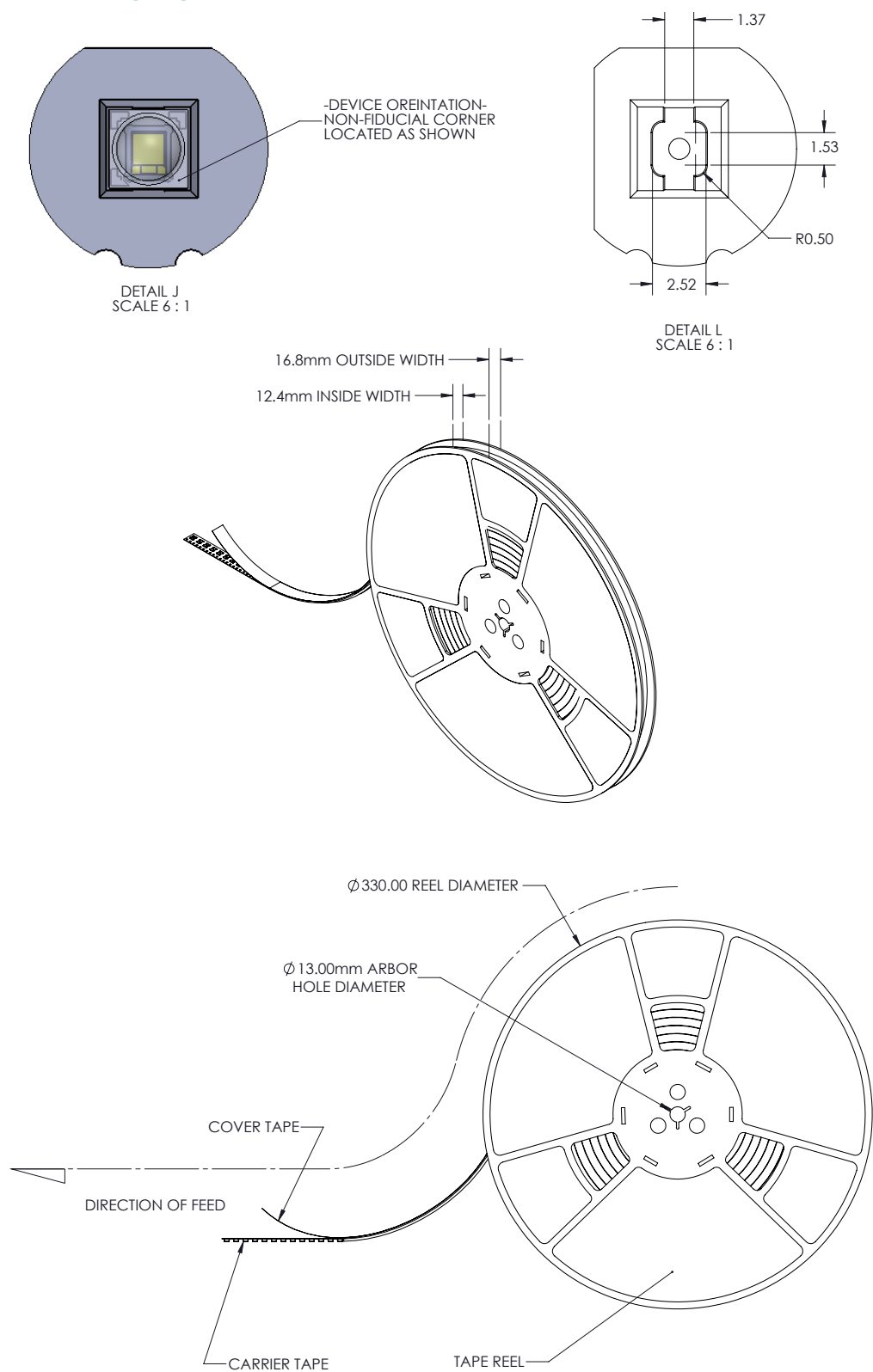


Figure 10. Emitter reel packaging.

# 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 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 T 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 T emitters are labeled with a four digit alphanumeric CAT code following the format below

ABCD

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

BC = Color bin (White: 7A, 7B etc.) and (Royal Blue: 04, 05, 06)

D =  $V_f$  bin (P, R)

## Luminous Flux and Forward Voltage Bins

Table 8 lists the standard photometric luminous flux bins for LUXEON T emitters (tested and binned at 700 mA and  $T_j = 85^\circ\text{C}$ ). 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 8. Flux Bins – White**

| Bin Code | Minimum Photometric Flux (lm) | Maximum Photometric Flux (lm) |
|----------|-------------------------------|-------------------------------|
| D        | 130                           | 140                           |
| E        | 140                           | 150                           |
| F        | 150                           | 160                           |
| G        | 160                           | 170                           |
| H        | 170                           | 180                           |
| J        | 180                           | 190                           |
| K        | 190                           | 200                           |
| L        | 200                           | 210                           |
| M        | 210                           | 220                           |
| N        | 220                           | 230                           |
| P        | 230                           | 240                           |
| Q        | 240                           | 250                           |
| R        | 250                           | 260                           |
| S        | 260                           | 270                           |
| T        | 270                           | 280                           |
| U        | 280                           | 290                           |
| V        | 290                           | 300                           |

# Radiometric Power Bins

Table 9 lists the standard radiometric flux bins for LUXEONT Royal Blue emitters LXHI-FWRB. Test conditions are 700 mA and junction temperature 85°C.

**Table 9. Radiometric Power Bins for Royal Blue**

| Bin Code | Minimum Radiometric Flux (mW) | Maximum Radiometric Flux (mW) |
|----------|-------------------------------|-------------------------------|
| A        | 950                           | 1000                          |
| B        | 1000                          | 1050                          |
| C        | 1050                          | 1100                          |
| D        | 1100                          | 1150                          |
| E        | 1150                          | 1200                          |

Table 10 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.

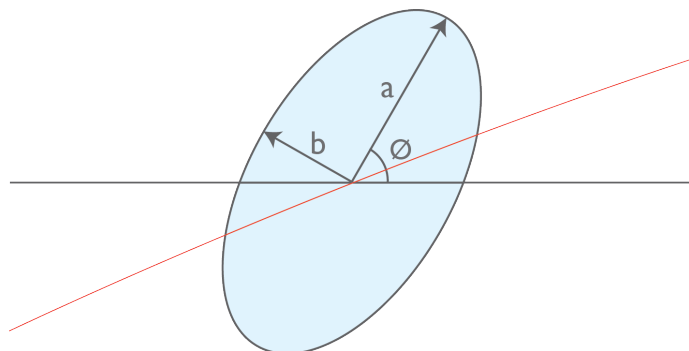
**Table 10.  $V_f$  Bins**

| 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 T 3-step and 5-step MacAdam Ellipse Color Definition

Tested at 700 mA DC & Junction Temperature = 85°C



**Table 11. LUXEON T Product Characteristics for 3-step MacAdam Ellipse**

| 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 12. LUXEON T Product Characteristics for 5-step MacAdam Ellipse**

| 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                  |
| 6500K            | Single 5-step MacAdam ellipse | (0.3123, 0.3282)      | 0.01115       | 0.00475       | 58.57                  |

Note for Tables 11 & 12:

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

## Peak Wavelength Bin Definition for LXHI-FWRB (Royal Blue)

**Table 13. Peak Wavelength Bin Structure for Royal Blue**

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

## 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, 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).

---

Philips Lumileds Lighting Company shall not be liable for any kind of loss of data or any other damages, direct, indirect or consequential, resulting from the use of the provided information and data. Although Philips Lumileds Lighting Company has attempted to provide the most accurate information and data, the materials and services information and data are provided "as is" and Philips Lumileds Lighting Company neither warranties, nor guarantees the contents and correctness of the provided information and data. Philips Lumileds Lighting Company reserves the right to make changes without notice. You as user agree to this disclaimer and user agreement with the download or use of the provided materials, information and data.

---



©2013 Philips Lumileds Lighting Company. All rights reserved.  
LUXEON is a registered trademark of the Philips Lumileds Lighting Company in the United States and other countries.

[www.philipslumileds.com](http://www.philipslumileds.com)  
[www.philipslumileds.cn.com](http://www.philipslumileds.cn.com)

LUXEONT Datasheet DS106 20130506