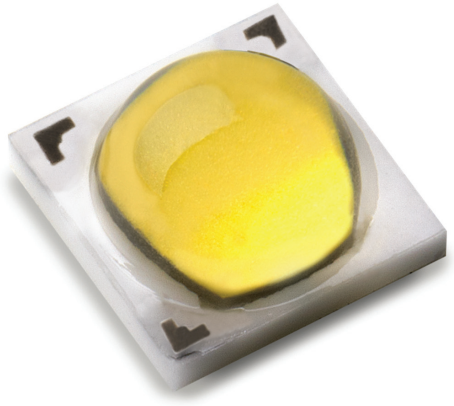
LUXEON T

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°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 [E352519] with level 4 enclosure consideration

Key Applications

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

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LUXEON T DS106 ©2013 Philips Lumileds Lighting Company.

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

Where:

c – designates minimum CRI performance (7 for 70 CRI, 8 for 80 CRI, 9 for 90 CRI, 1 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 – F W 2 7 - 3

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

LXH1 - FWRB - 1000

Lumen Maintenance

LUXEON T products are tested in compliance with LM-80. Please visit **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_f)			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 ± 6.5% on luminous flux and ± 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	LXH1 - FWRB	950	1040	53%

Note for Table 2:

1. Philips Lumileds maintains a tolerance of ± 6.5% on flux measurements.
2. Test current is 700 mA for LXR0-SR00 products.

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Optical Characteristics

LUXEON T at Test Current[1], Junction Temperature = 85°C

Table 3.

Nominal ANSI CCT	Part Number	Color Temperature CCT Typical	Typical Total Included Angle[2] (degrees) $\theta_{0.90V}$	Typical Viewing Angle[3] (degrees) 2θ 1/2
2700K	LXH8-FW27-Y	2725K	160°	120°
3000K	LXH7-FW30 LXH8-FW30-Y LXH9-FW30-Y	3045K	160°	120°
3500K	LXH8-FW35-Y	3465K	160°	120°
4000K	LXH7-FW40 LXH8-FW40-Y	3985K	160°	120°
5000K	LXH7-FW50 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 ½ 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, [1] (V)		Typical Temperature Coefficient of Forward Voltage[2] (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
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_J = 25°C and T_J = 110°C at I_f = 700 mA.

Absolute Maximum Ratings

Table 5.

Parameter	LUXEON T	
DC Forward Current [1] [2]	1050 mA	1200 mA
Peak Pulsed Forward Current [1] [3]	1200 mA	1350 mA
LED Junction Temperature [1]	150°C	135°C
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A per JEDEC JS-001-2012	
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) [4] [5]	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 ≥100 Hz and amplitude ≤ 150 mA are acceptable, assuming the average current throughout each cycle does not exceed the maximum allowable DC Forward Current at the corresponding maximum junction temperature.
3. Pulsed operation with a peak drive current equal to the stated Peak Pulsed Forward Current is acceptable if the pulse on-time is ≤ 5 ms per cycle and the duty cycle is ≤ 50%.
4. Transient reverse voltages and surge currents due to electrical switching or supply interruptions are acceptable if these events do not last for more than 10ms, the amplitude of the reverse voltage does not exceed 5V and the reverse current is less than 200µA.
5. 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
1	unlimited	≤ 30°C / 85% RH	168h + 5 / - 0	85°C / 85% RH

Reflow Soldering Characteristics

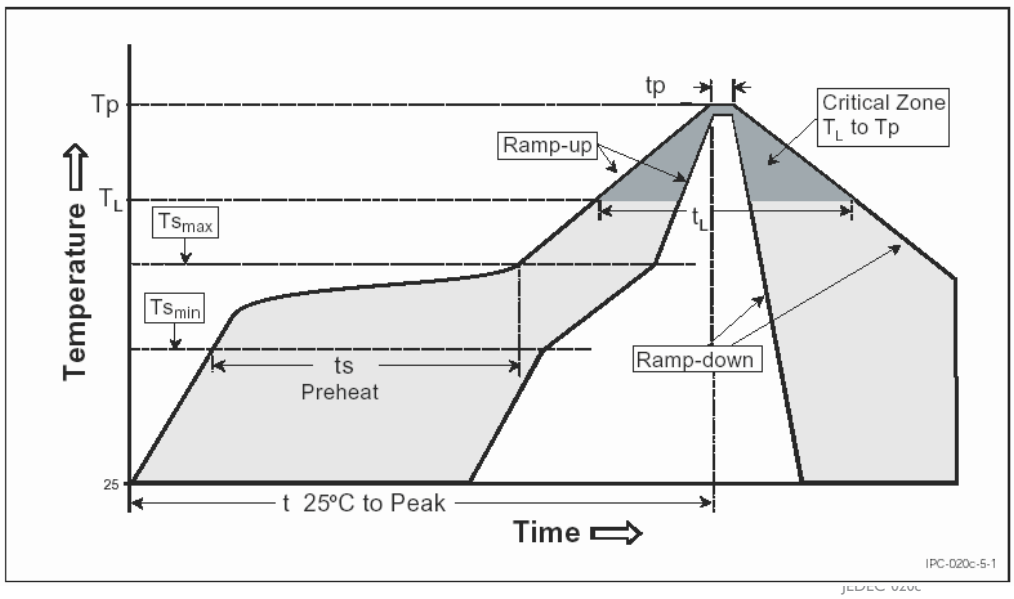

Figure 1. Temperature profile for Table 7.

Table 7.

Profile Feature	Lead Free Assembly
Average Ramp-Up Rate (Ts_{max} to T_p)	3°C / second max
Preheat Temperature Min (Ts_{min})	150°C
Preheat Temperature Max (Ts_{max})	200°C
Preheat Time (ts_{min} to ts_{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

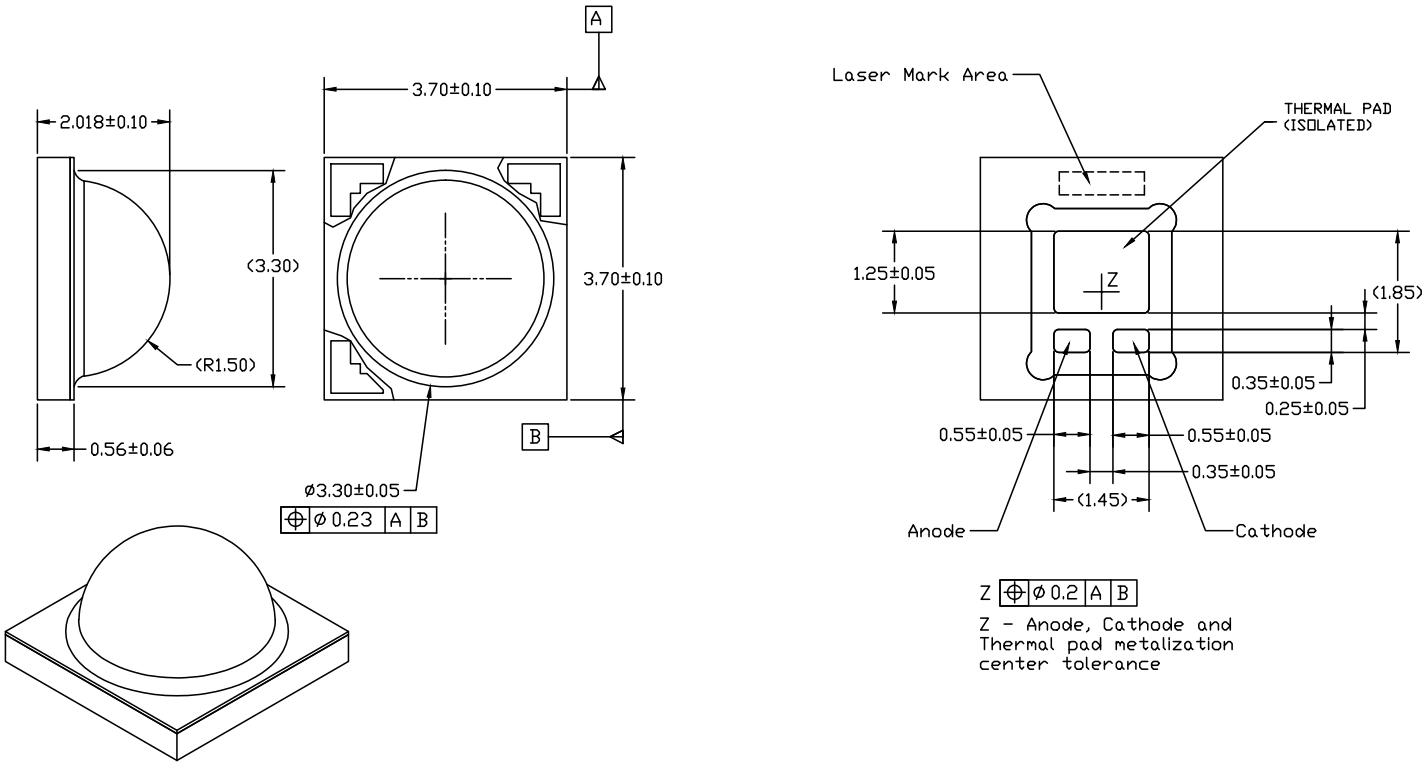

Figure 2.

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

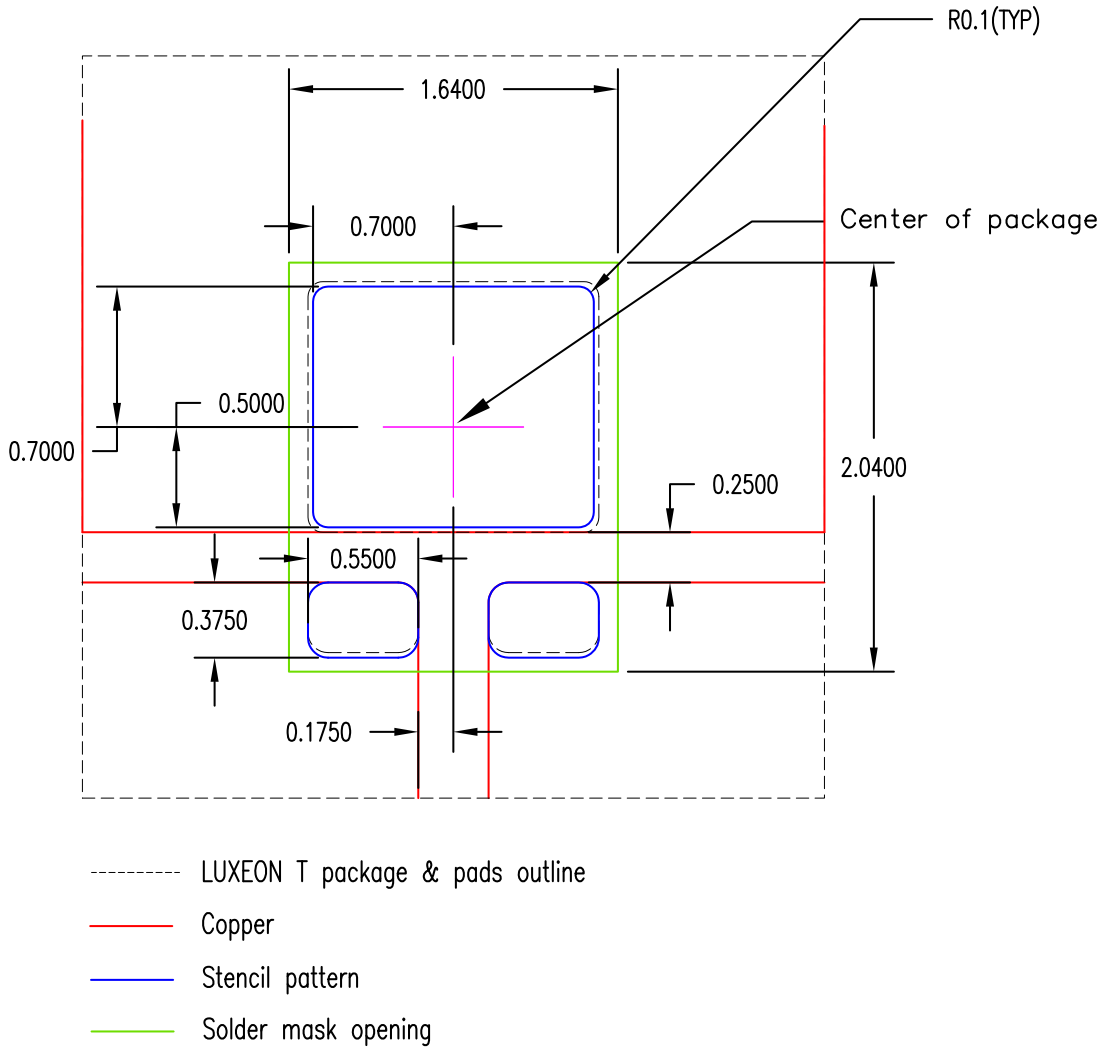

Figure 3. Solder pad layout.

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 and www.philipslumileds.cn.com.

Relative Spectral Distribution vs. Wavelength Characteristics

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

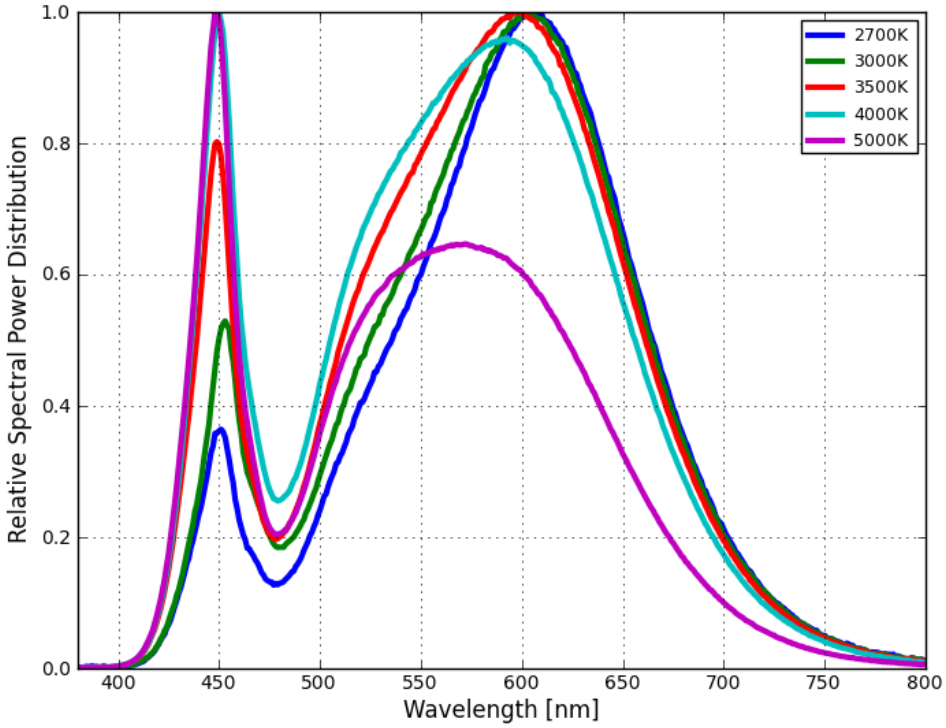

Figure 4. Color Spectrum of LXHc-FWxx.

LXH1-FWRB (Royal Blue) at Test Current, Junction Temperature = 85°C

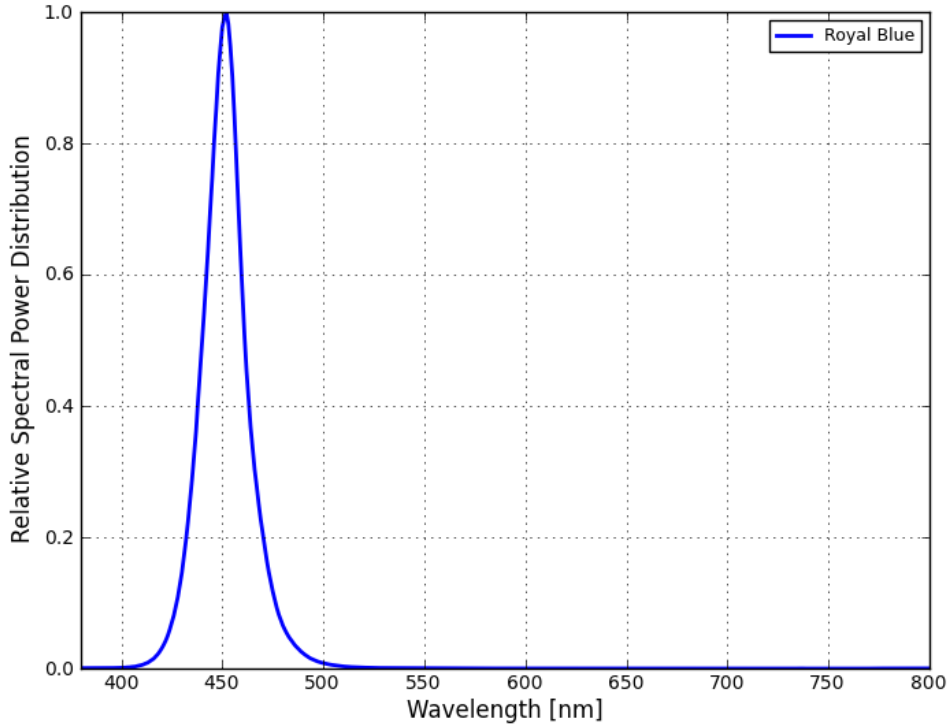

Figure 5. Color Spectrum of LXH1-FWRB.

Typical Light Output Characteristics

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

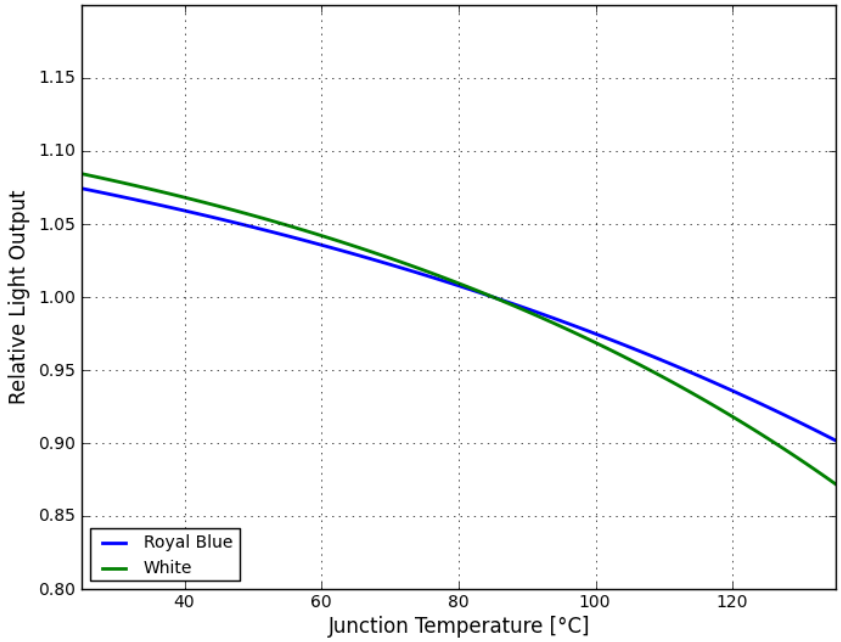

Figure 6. Relative light output vs. junction temperature, LXHc-FWxx.

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

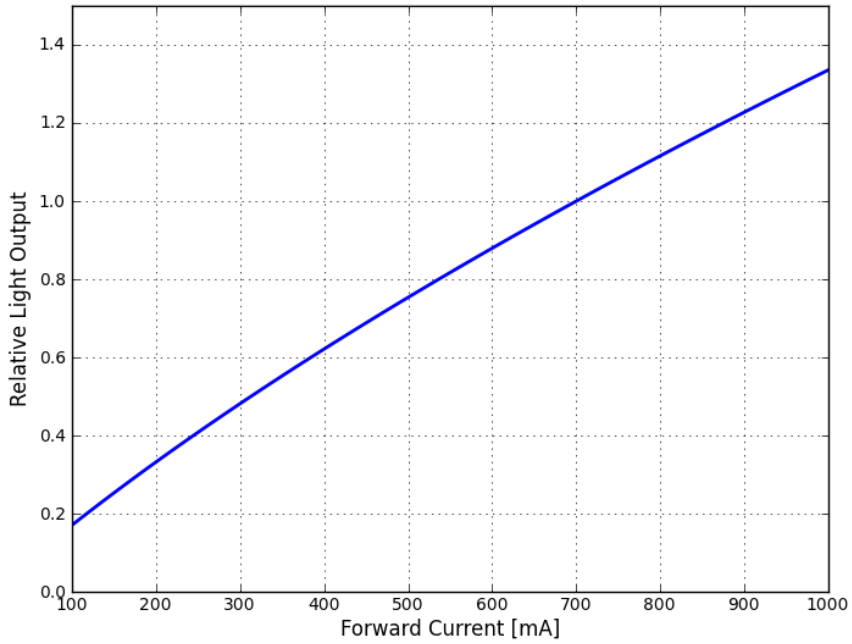

Figure 7. Typical relative luminous flux vs. forward current, LXHc-FWxx.

Typical Forward Current Characteristics

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

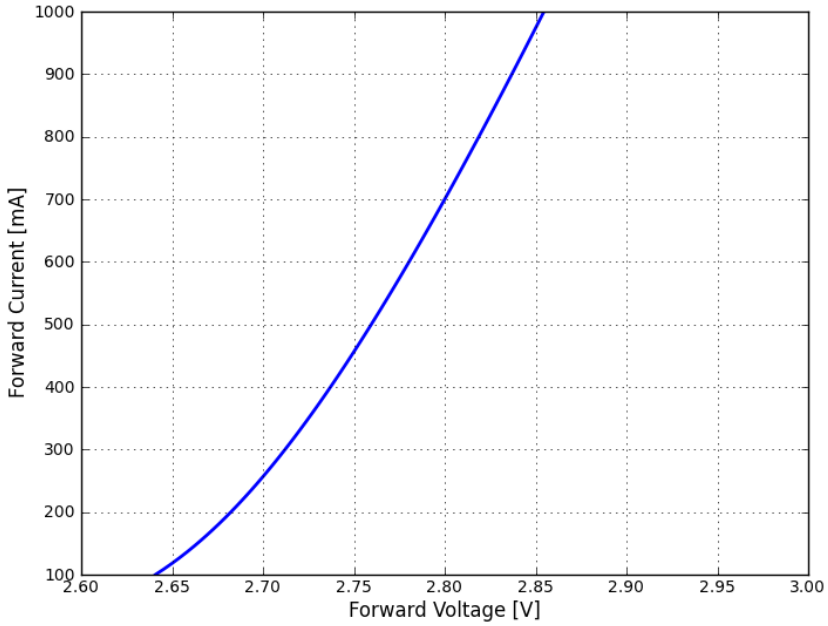

Figure 8. Typical forward current vs. forward voltage, LXHc-FWxx.

Emitter Pocket Tape Packaging

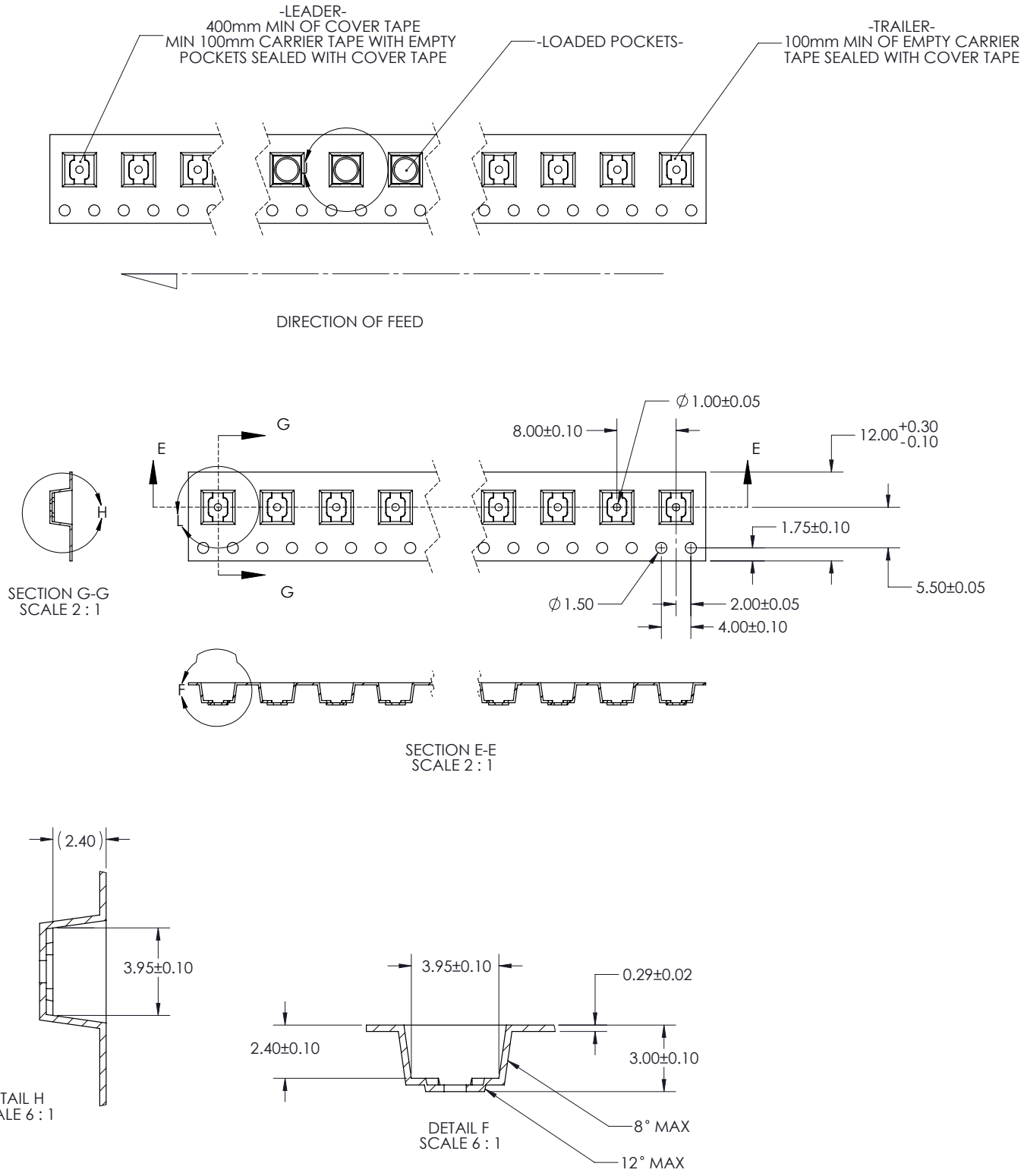

Figure 9. Emitter pocket tape packaging.

Emitter Reel Packaging

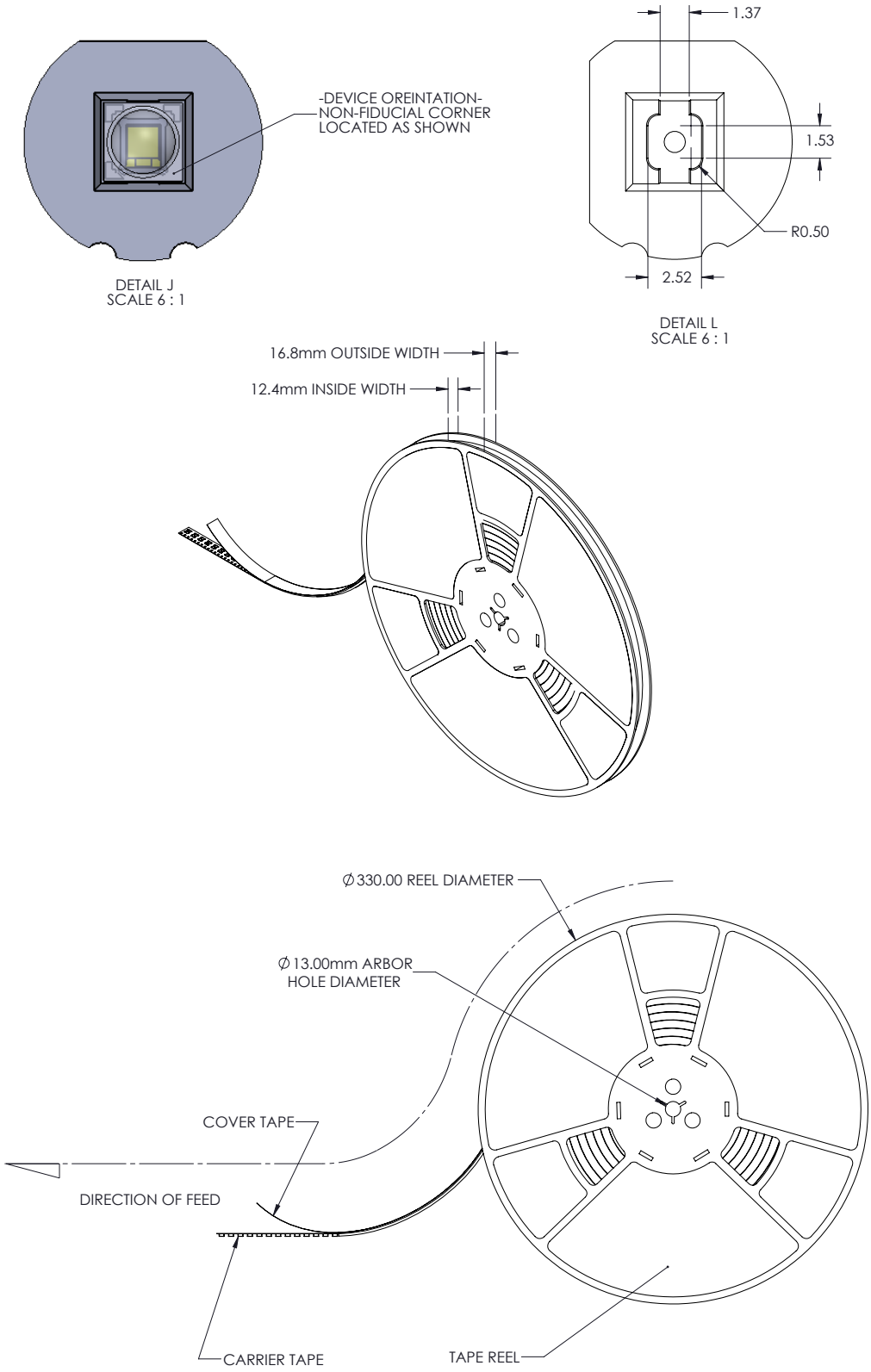

Figure 10. Emitter reel packaging.

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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 CAT code following the format below:

ABCD

A
Flux Bin
see flux bin table

B	
CCT	
0	Royal Blue
1	6500K
2	5700K
3	5000K
5	4000K
6	3500K
7	3000K
8	2700K

C	
SDCM Definition / Wavelength	
3	3-step White
4	445-450 nm Royal Blue
5	450-455 nm Royal Blue / 5-step White
6	455-460 nm Royal Blue
A	5-step White
B	
C	
D	

D		
Vf	min	max
P	2.50	2.75
R	2.75	3.00
S	3.00	3.25

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°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)
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
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 LUXEON T Royal Blue emitters LXH1-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

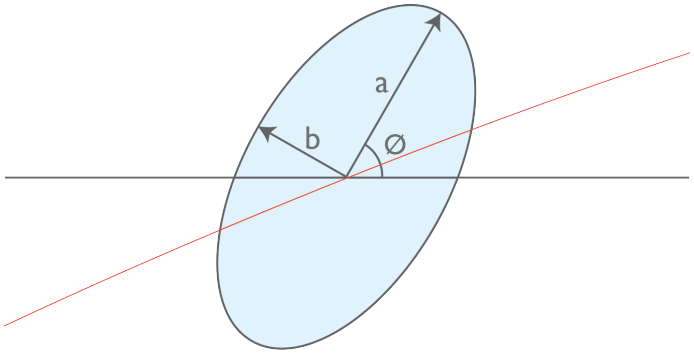

Table 11. LUXEON T Product Characteristics for 3-step MacAdam Ellipse

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 ± 0.005 on x, y color coordinates.

Peak Wavelength Bin Definition for LXH1-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

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Who We Are

Philips Lumileds focuses on one goal: Creating the world's highest performing LEDs. The company pioneered the use of solid-state lighting in breakthrough products such as the first LED backlit TV, the first LED flash in camera phones, and the first LED daytime running lights for cars. Today we offer the most comprehensive portfolio of high quality LEDs and uncompromising service.

Philips Lumileds brings LED's qualities of energy efficiency, digital control and long life to spotlights, downlights, high bay and low bay lighting, indoor area lighting, architectural and specialty lighting as well as retrofit lamps. Our products are engineered for optimal light quality and unprecedented efficacy at the lowest overall cost. By offering LEDs in chip, packaged and module form, we deliver supply chain flexibility to the inventors of next generation illumination.

Philips Lumileds understands that solid state lighting is not just about energy efficiency. It is about elegant design. Reinventing form. Engineering new materials. Pioneering markets and simplifying the supply chain. It's about a shared vision. Learn more about our comprehensive portfolio of LEDs at www.philipslumileds.com.

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