

LUXEON K

Easy to use array solutions
for omni-directional
applications requiring
high flux and efficacy

Technical Datasheet DS102

LUXEON
NEVER BEFORE POSSIBLE



LUXEON K

High Efficiency Arrays White and Royal Blue

Introduction

The LUXEON® K arrays deliver high flux at high efficacy in a small, easy to use package. The high lumen density enables high light output in thermally and space constrained systems like retrofit lamps and high efficiency in systems like downlights aiming for high energy efficiency. The small size bolt down package enables simple assembly in space constrained systems. With *Freedom From Binning*, every LUXEON K white product falls within a single 3-step MacAdam ellipse positioned around the center point of the ANSI nominal CCT bins to deliver tight Correlated Color Temperature control to ensure consistency in system color point. In addition, these parts deliver the lumen maintenance and reliability that all LUXEON LEDs are renowned for. This document contains the performance data needed to design and engineer LUXEON K based applications.

- Family of modules covering 400 to over 4000 lumens
- *Freedom From Binning* with single 3 step MacAdam ellipse color performance for white products, tight forward voltage range of $\pm 5\%$, and single flux bin
- Exceed ENERGY STAR® lumen maintenance requirements
- High efficacy for sustainable design, high lumen density, low thermal resistance, and illumination grade color over angle
- Simplifies system design/assembly, enabling fast time to market
- Guaranteed performance at common application condition of 350 mA and $T_j = 85^\circ\text{C}$.

PHILIPS
LUMILEDS

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General Information

Product Nomenclature

LUXEON K products are specified and binned “hot” under conditions comparable to those found in “real-world” lighting products. The test conditions are at 350 mA D.C. with junction temperature at 85°C.

The part number designation is explained as follows:

L X K A - P B C D - E F G H

Where:

- A — designates minimum CRI performance (value 8 = 80 minimum, value 9 = 90 minimum, value 0 for Royal Blue)
- B — designates color (value W = White, value R = Royal Blue)
- C, D — designates nominal ANSI CCT (value 27 = 2700K, 30 = 3000K, 35 = 3500K, 40 = 4000K, 50 = 5000K, and 04 = Royal Blue 447.5nm - 452.5nm peak wavelength)
- E, F — custom spec designation
- G, H — emitter count

Therefore, 3000K products specified at 350 mA 85°C follow the part numbering scheme:

- L X K 8 - P W 3 0 - 0 0 0 4 for LUXEON K White 3000K 4-up
- L X K 8 - P W 3 0 - 0 0 0 8 for LUXEON K White 3000K 8-up
- L X K 0 - P R 0 4 - 0 0 0 8 for LUXEON K Royal Blue 8-up

Average Lumen Maintenance Characteristics

Lumen maintenance for solid-state lighting devices (LEDs) is typically defined in terms of the percentage of initial light output remaining after a specified period of time. Philips Lumileds projects that LUXEON K products will deliver, on average, 70% lumen maintenance (L70) at 50,000 hours of operation at a forward current of up to 700 mA. This projection is based on constant current operation with junction temperature maintained at or below 125°C. This performance is based on independent test data, Philips Lumileds historical data from tests run on similar material systems, and internal LUXEON reliability testing. Observation of design limits included in this data sheet is required in order to achieve this projected lumen maintenance.

Environmental Compliance

Philips Lumileds is committed to providing environmentally friendly products to the solid-state lighting market. LUXEON K is compliant to the European Union directives on the restriction of hazardous substances in electronic equipment, namely the RoHS directive. Philips Lumileds will not intentionally add the following restricted materials to the LUXEON K: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

Product Selection

Product Selection Guide for LUXEON K White, Junction Temperature = 85°C, Current = 350 mA

Table 1.

Nominal CCT	Emitter Count	Part Number	Minimum CRI	Typical CRI	Minimum Flux (lm) (350 mA)	Typical Flux (lm) (350 mA)	Maximum Flux (lm) (350 mA)
2700K	4	LXK8-PW27-0004	80	83	310	345	370
2700K	4	LXK8-PW27-0004-A	80	83	360	383	430
2700K	8	LXK8-PW27-0008	80	83	680	690	810
2700K	8	LXK8-PW27-0008-A	80	83	730	765	870
2700K	12	LXK8-PW27-0012	80	83	990	1045	1180
2700K	12	LXK8-PW27-0012-A	80	83	1100	1148	1320
2700K	16	LXK8-PW27-0016	80	83	1380	1395	1650
2700K	16	LXK8-PW27-0016-A	80	83	1480	1530	1770
2700K	24	LXK8-PW27-0024	80	83	1960	2090	2350
2700K	24	LXK8-PW27-0024-A	80	83	2230	2296	2670
3000K	4	LXK8-PW30-0004	80	83	330	370	390
3000K	4	LXK8-PW30-0004-A	80	83	380	396	450
3000K	8	LXK8-PW30-0008	80	83	730	740	870
3000K	8	LXK8-PW30-0008-A	80	83	760	783	910
3000K	12	LXK8-PW30-0012	80	83	1070	1125	1280
3000K	12	LXK8-PW30-0012-A	80	83	1140	1175	1360
3000K	16	LXK8-PW30-0016	80	83	1475	1500	1770
3000K	16	LXK8-PW30-0016-A	80	83	1520	1568	1820
3000K	24	LXK8-PW30-0024	80	83	2100	2250	2520
3000K	24	LXK8-PW30-0024-A	80	83	2280	2351	2730
3500K	4	LXK8-PW35-0004	80	83	400	423	480
3500K	8	LXK8-PW35-0008	80	83	820	845	980
3500K	12	LXK8-PW35-0012	80	83	1200	1265	1440
3500K	16	LXK8-PW35-0016	80	83	1590	1703	1900
3500K	24	LXK8-PW35-0024	80	83	2420	2570	2900
4000K	4	LXK8-PW40-0004	80	83	380	410	450
4000K	4	LXK8-PW40-0004-A	80	83	420	443	500
4000K	8	LXK8-PW40-0008	80	83	780	815	930
4000K	8	LXK8-PW40-0008-A	80	83	820	886	980
4000K	12	LXK8-PW40-0012	80	83	1120	1240	1340
4000K	12	LXK8-PW40-0012-A	80	83	1250	1329	1500
4000K	16	LXK8-PW40-0016	80	83	1590	1650	1900
4000K	16	LXK8-PW40-0016-A	80	83	1680	1772	2010
4000K	24	LXK8-PW40-0024	80	83	2260	2475	2710
4000K	24	LXK8-PW40-0024-A	80	83	2530	2660	3030

Table 1 continued on page 5.

Table 1 Continued.

Nominal CCT	Emitter Count	Part Number	Minimum CRI	Typical CRI	Minimum Flux (lm) (350 mA)	Typical Flux (lm) (350 mA)	Maximum Flux (lm) (350 mA)
5000K	4	LXK8-PW50-0004	80	83	440	463	530
5000K	8	LXK8-PW50-0008	80	83	890	933	1070
5000K	12	LXK8-PW50-0012	80	83	1310	1389	1570
5000K	16	LXK8-PW50-0016	80	83	1760	1850	2110
5000K	24	LXK8-PW50-0024	80	83	2650	2767	3180

Notes for Table 1:

- Philips Lumileds maintains a tolerance of $\pm 6.5\%$ on luminous flux and ± 2 on CRI measurements.
- LUXEON K products with even higher luminous flux levels will become available in the future. Please consult Philips Lumileds for more information.

Product Selection Guide for LUXEON K Royal Blue, Junction Temperature = 85°C, Current = 350 mA

Table 2.

Color	Emitter Count	Part Number	Minimum Radiometric Power (mW)	Typical Radiometric Power (mW)	Maximum Radiometric Power (mW)	Typical Radiant Efficiency (%)
Royal Blue	8	LXK0-PR04-0008	4500	4670	5400	62%
Royal Blue	16	LXK0-PR04-0016	9000	9350	10800	62%

Optical Characteristics

LUXEON K White at Test Current ^[1], Junction Temperature = 85°C

Table 3.

Part Number	Nominal CCT	Color Temperature ^[2]		Typical Total Included Angle ^[3] (degrees) θ_{90V}	Typical Viewing Angle ^[4] $2\theta_{1/2}$ (degrees)
		CCT	Typical		
LXKx-PW27-xxxx	2700K		2725K	125	100
LXKx-PW30-xxxx	3000K		3045K	125	100
LXKx-PW35-xxxx	3500K		3465K	125	100
LXKx-PW40-xxxx	4000K		3985K	125	100
LXKx-PW50-xxxx	5000K		5028K	125	100

Notes for Table 3:

1. Test current is 350 mA for all LXKx-PWxx products.
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.
4. All white products are built with Indium Gallium Nitride (InGaN).

LUXEON K Royal Blue (LXK0-PRxx) at Test Current ^[1], Junction Temperature = 85°C

Table 4.

Part Color	Peak Wavelength, λ_p ^[2]			Typ Spectral Half-width (nm) ^[3] $\Delta\lambda_{1/2}$	Typ Temp Coefficient of Peak Wavelength (nm/°C) $\Delta\lambda_{1/2}$	Typical Total Included Angle (degrees) ^[4] θ_{90V}	Typical Viewing Angle (degrees) ^[5] $2\theta_{1/2}$
	Min.	Typical	Max.				
Royal Blue	447.5nm	450nm	452.5nm	20	0.05	140	116

Notes for Table 4:

1. Test current is 350 mA for all LXK0-PR04 products.
2. Royal Blue product has single peak wavelength bin.
3. Spectral half-width is 1/2 of the peak intensity.
4. Total included angle at which 90% of total radiometric power is captured.
5. 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 350 mA for LUXEON K White and Royal Blue, Junction Temperature = 85°C

Table 5.

Model	Forward Voltage V_f ^[1] (V)			Typical Temperature Coefficient of Forward Voltage ^[2] (mV/°C) $\Delta V_f / \Delta T_j$	Typical Thermal Resistance Junction to Case ^[3] (°C/W) $R\theta_{j-c}$
	Min.	Typ.	Max.		
LXKx-Pxxx-xx04	10	10.5	11	-6.25	3.0
LXKx-Pxxx-xx08	20	21	22	-12.5	1.5
LXKx-Pxxx-xx12	30	31.5	33	-18.75	1.0
LXKx-Pxxx-xx16	40	42	44	-25	0.75
LXKx-Pxxx-xx24	60	63	66	-37.5	0.5

Notes for Table 5:

1. Philips Lumileds maintains a tolerance of $\pm 0.06V$ per single emitter on forward voltage measurements. ($\pm 0.24V$ for LXKx-Pxxx-xx04, $\pm 0.48V$ for LXKx-Pxxx-xx08, $\pm 0.72V$ for LXKx-Pxxx-xx12, $\pm 0.96V$ for LXKx-Pxxx-xx16, and $\pm 1.44V$ for LXKx-Pxxx-xx24).
2. Measured between $T_j = 25^\circ C$ and $T_j = 110^\circ C$ at $I_f = 350$ mA.
3. Junction temperature to back of the PCB.

Typical Electrical Characteristics at 700 mA for LUXEON K White and Royal Blue, Junction Temperature = 85°C

Table 6.

Model	Typical Forward Voltage V_f (V)
LXKx-Pxxx-x004	11
LXKx-Pxxx-x008	22
LXKx-Pxxx-x012	33
LXKx-Pxxx-x016	44
LXKx-Pxxx-x024	66

Absolute Maximum Ratings

Table 7.

Parameter	Maximum Performance
DC Forward Current (mA) ^[3]	1050
Peak Pulsed Forward Current (mA) ^[3]	1050
Average Forward Current (mA) ^[3]	1050
ESD Sensitivity	< 8000V Human Body Model (HBM) Class 3A JESD22-A114-E < 400V Machine Model (MM) Class B JESD22-A115-B
LED Junction Temperature ^[1]	125°C
Operating Case Temperature	-40°C - 125°C
Storage Temperature	-40°C - 125°C
Reverse Voltage (V _r)	See Note 2

Notes for Table 7:

1. Proper current derating must be observed to maintain junction temperature below the maximum.
2. LUXEON Power LEDs are not designed to be driven in reverse bias.
3. Residual periodic variations due to power conversion from alternating current (AC) to direct current (DC), also called “ripple”, with frequencies $\geq 100\text{Hz}$ and amplitude $\leq 1200\text{ mA}$ are acceptable, assuming the average current throughout each cycle does not exceed 1000 mA.

Electrical Lead Soldering Characteristics

Please refer to Application Brief AB102 for LUXEON K.

Mechanical Dimensions

LXKx-Pxxx-0x04

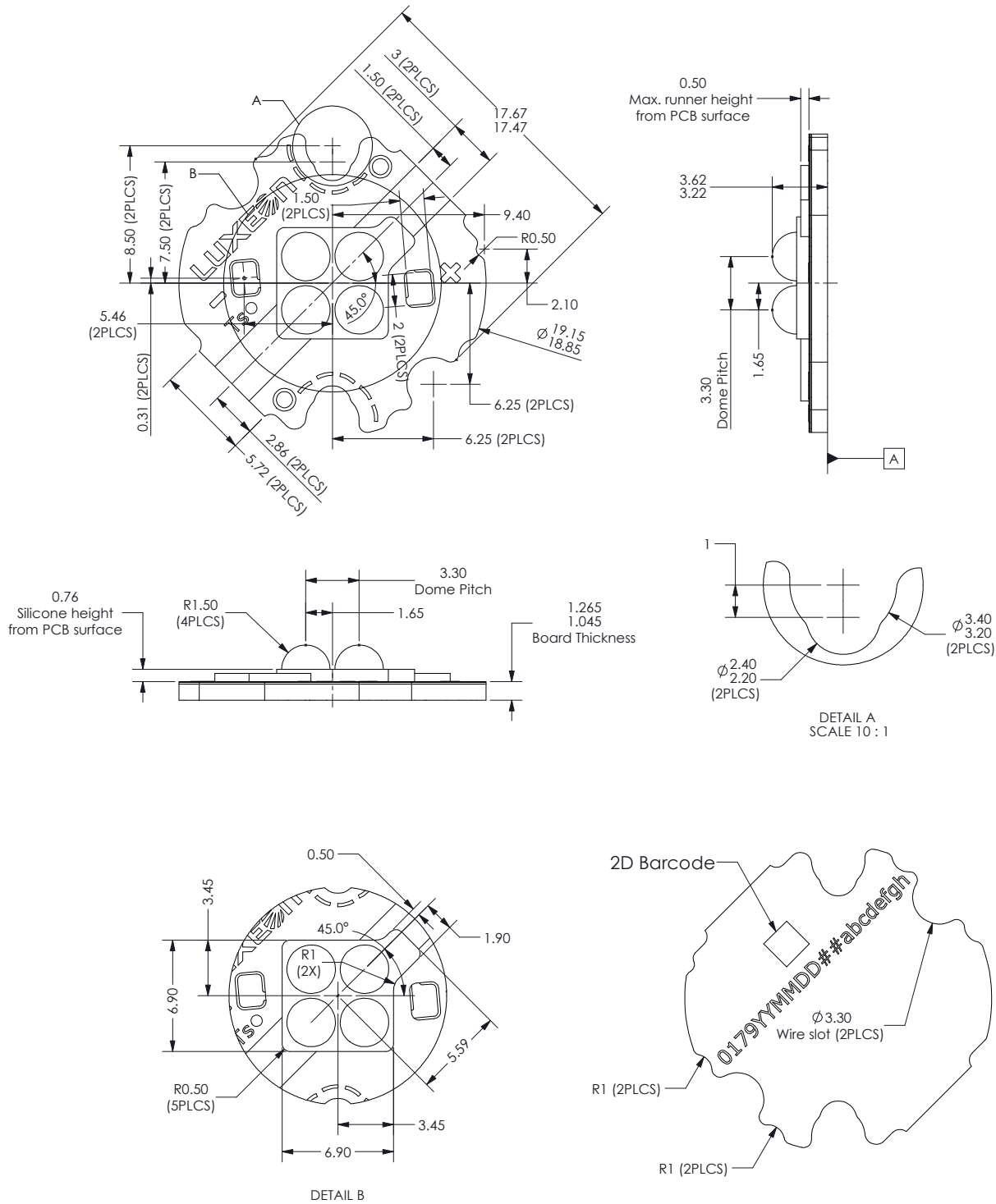


Figure 1. Dimensions for LXK8-PW27-0004, LXK8-PW30-0004, LXK8-PW35-0004, LXK8-PW40-0004, LXK8-PW50-0004.

Note for Figure 1:

- All dimensions are in millimeters.

LXKx-Pxxx-0x08

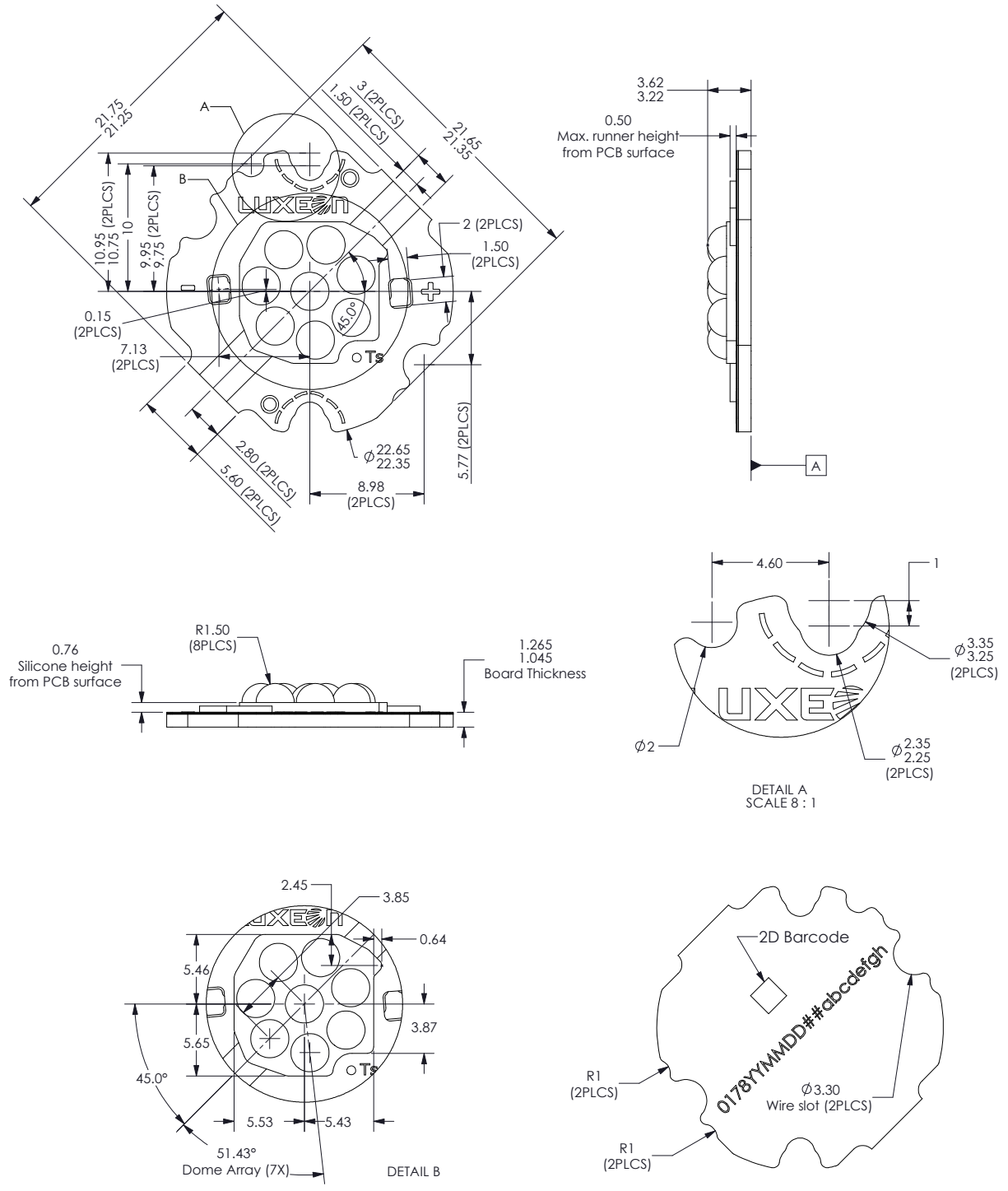


Figure 2. LXK8-PW27-0008, LXK8-PW30-0008, LXK8-PW35-0008, LXK8-PW40-0008, LXK8-PW50-0008.

Note for Figure 2:

- All dimensions are in millimeters.

LXKx-Pxxx-0x12

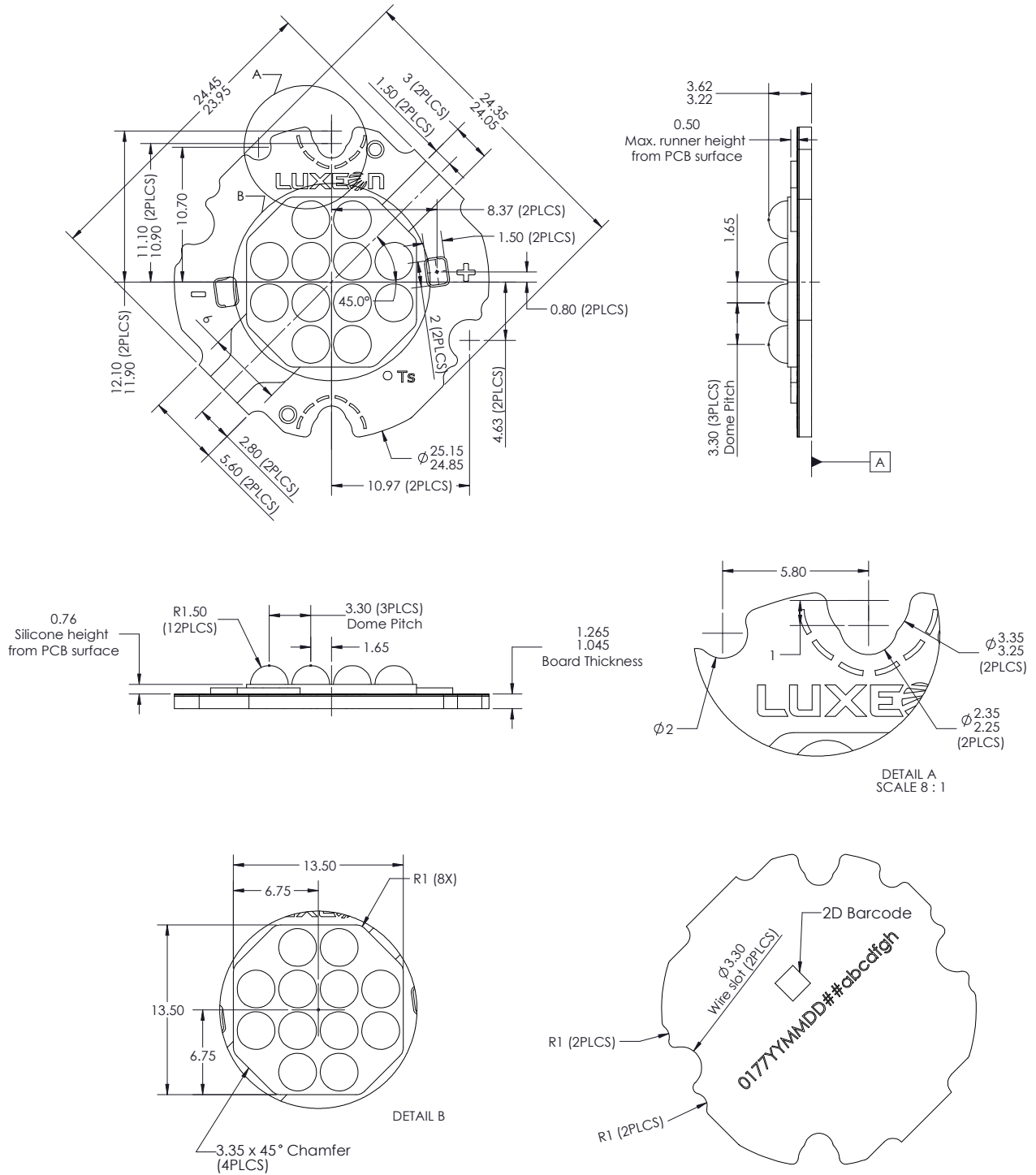


Figure 3. LXK8-PW27-0012, LXK8-PW30-0012, LXK8-PW35-0012, LXK8-PW40-0012, LXK8-PW50-0012.

Note for Figure 3:

- All dimensions are in millimeters.

LXKx-Pxxx-0x16

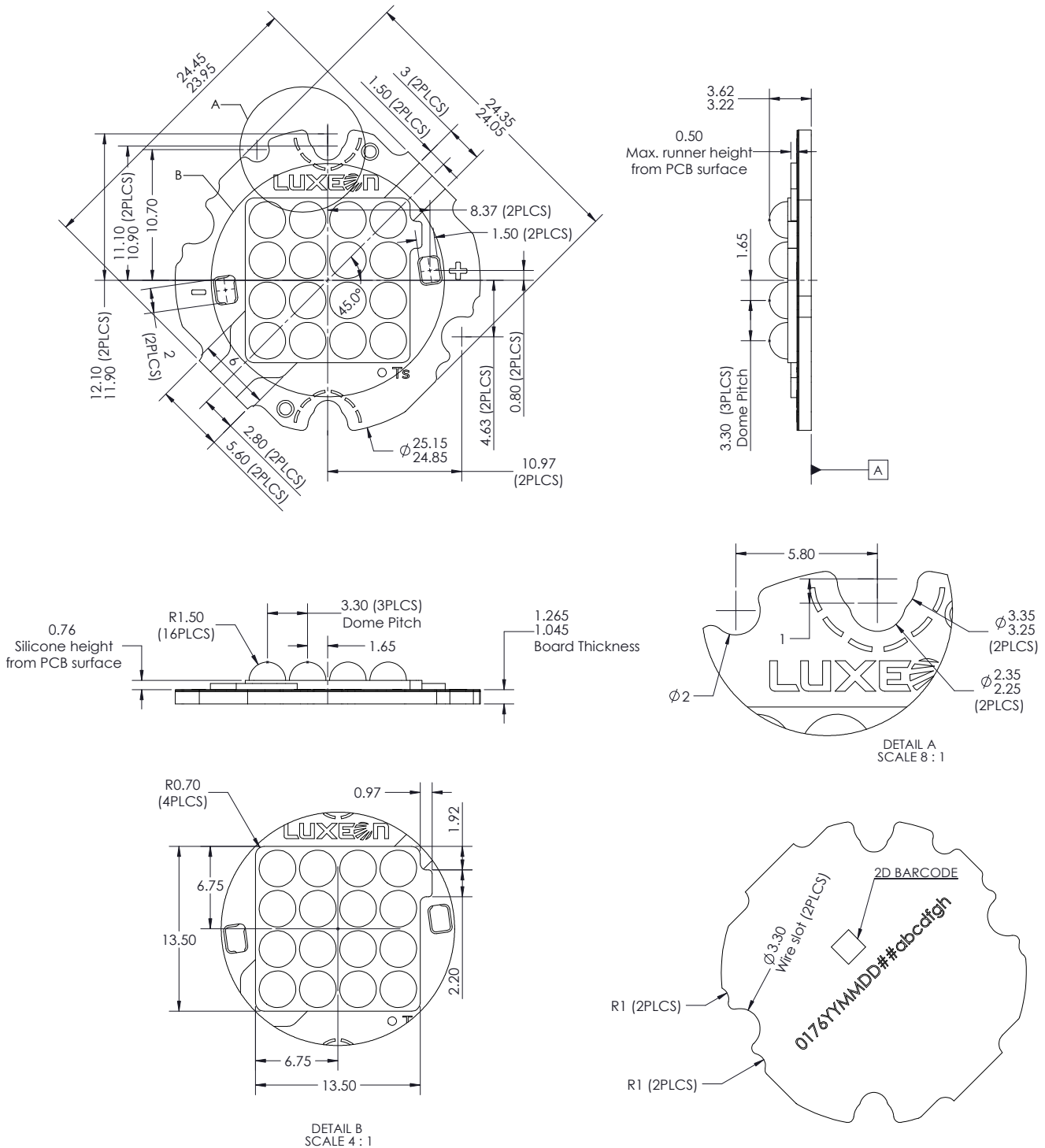


Figure 4. LXK8-PW27-0016, LXK8-PW30-0016, LXK8-PW35-0016, LXK8-PW40-0016, LXK8-PW50-0016.

Note for Figure 4:

- All dimensions are in millimeters.

LXKx-Pxxx-xx24

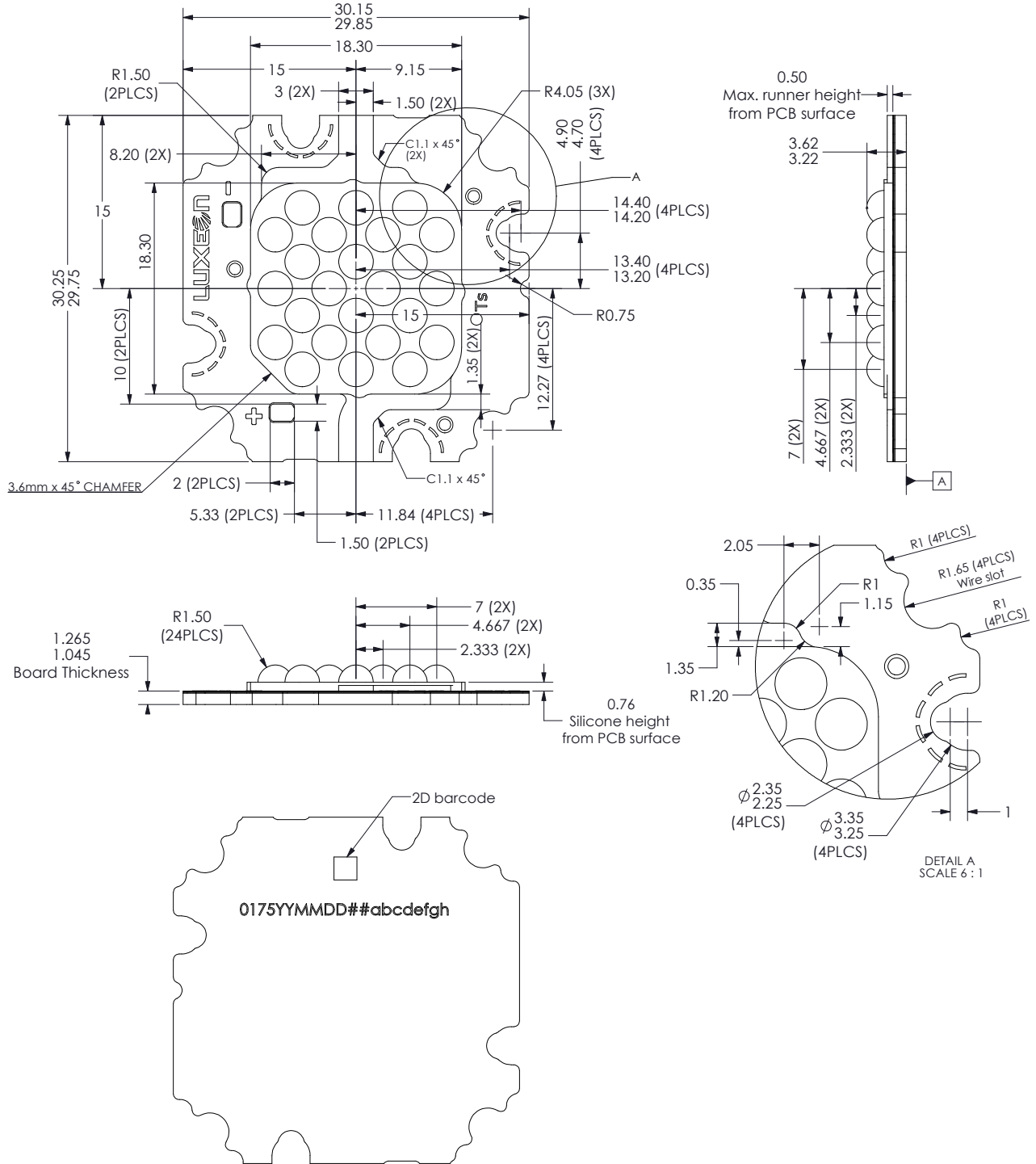


Figure 5. LXK8-PW27-0024, LXK8-PW30-0024, LXK8-PW35-0024, LXK8-PW40-0024, LXK8-PW50-0024.

Note for Figure 5:

- All dimensions are in millimeters.

Relative Spectral Distribution vs. Wavelength Characteristics

LXK8-PWxx-xxxx at Test Current, Junction Temperature = 85°C

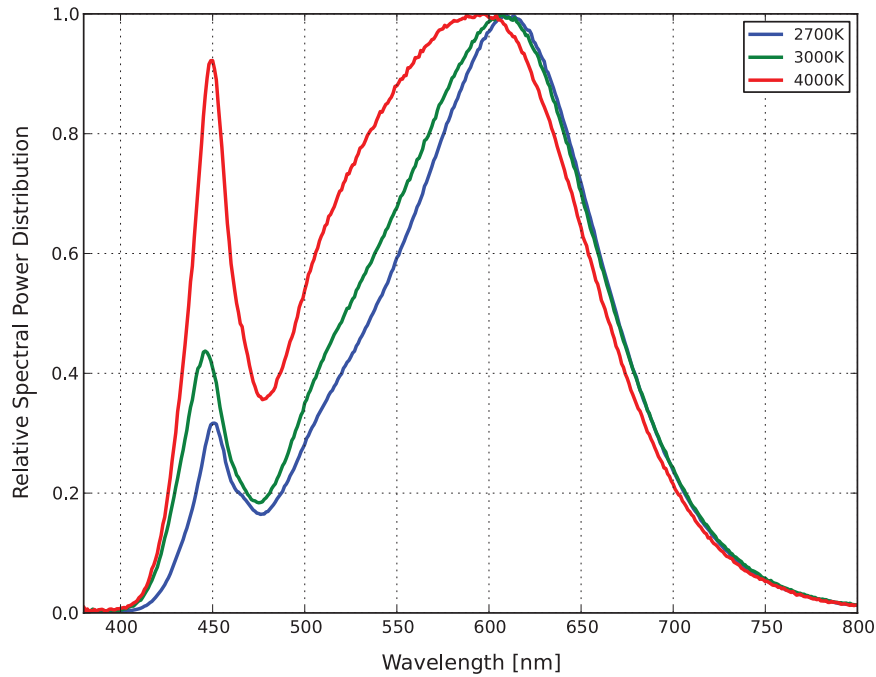


Figure 6. Color spectrum of LXK8-PWxx-xxxx product, integrated measurement.

LXK0-PR04-xxxx (Royal Blue) at Test Current, Junction Temperature = 85°C

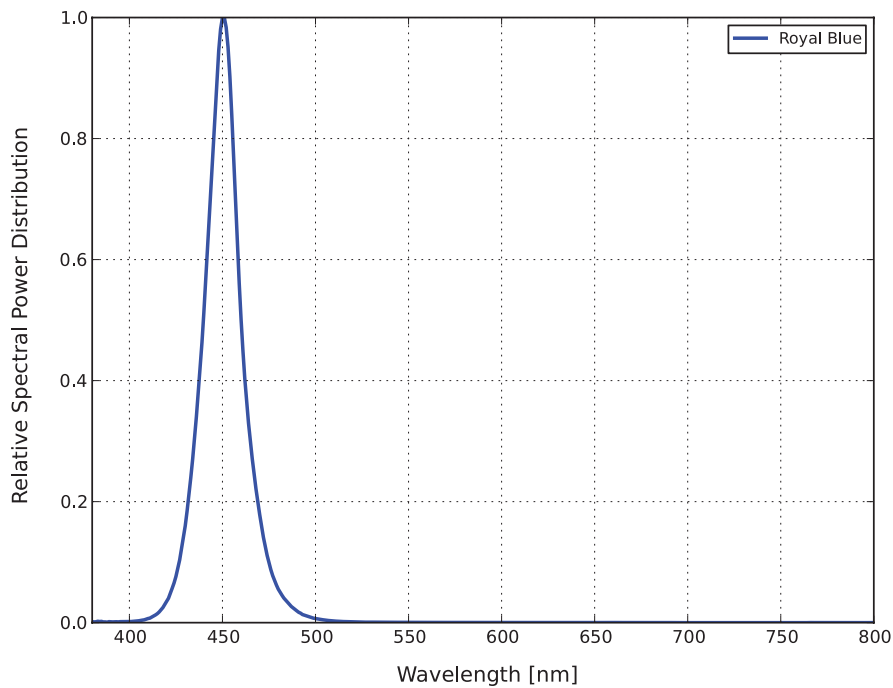


Figure 7. Color spectrum of LXK0-PR04-xxxx product, integrated measurement.

Light Output Characteristics over Temperature

All LUXEON K products at Test Current, Normalized at 350 mA,
Junction Temperature = 85°C

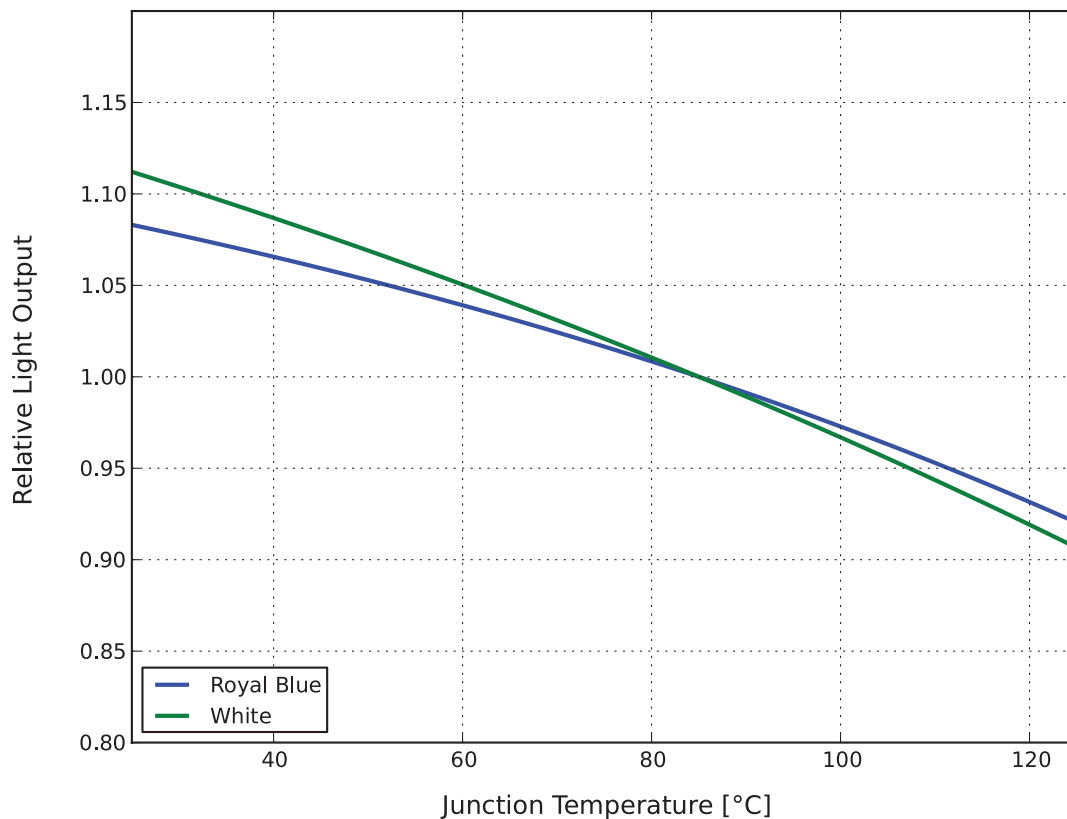


Figure 8. Typical relative flux vs. junction temperature at test current.

Typical Forward Current Characteristics

Typical Forward Current vs. Forward Voltage LUXEON K 4-up Products, Junction Temperature = 85°C

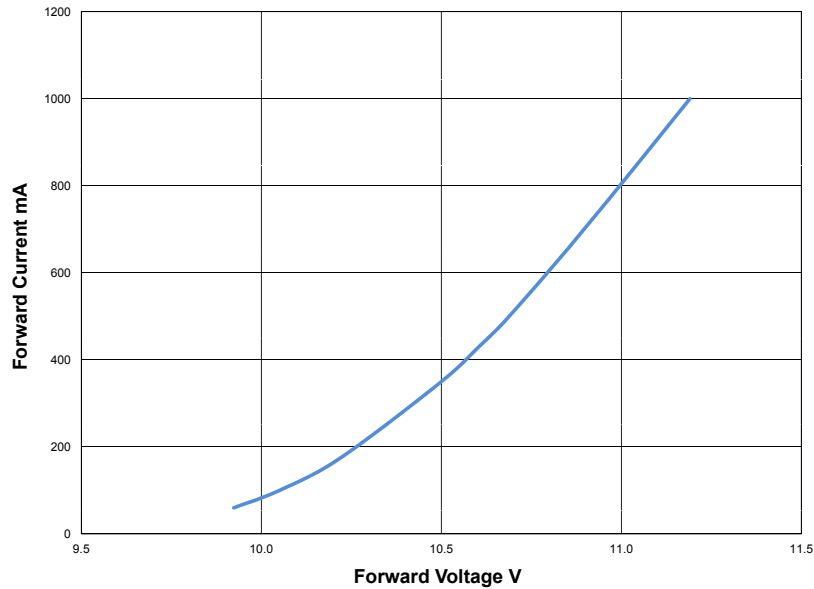


Figure 9. Forward current vs. forward voltage for LXXK8-PW27-0004, LXXK8-PW30-0004, LXXK8-PW35-0004, LXXK8-PW40-0004, LXXK8-PW50-0004 4-up products.

Typical Forward Current vs. Forward Voltage LUXEON K 8-up Products, Junction Temperature = 85°C

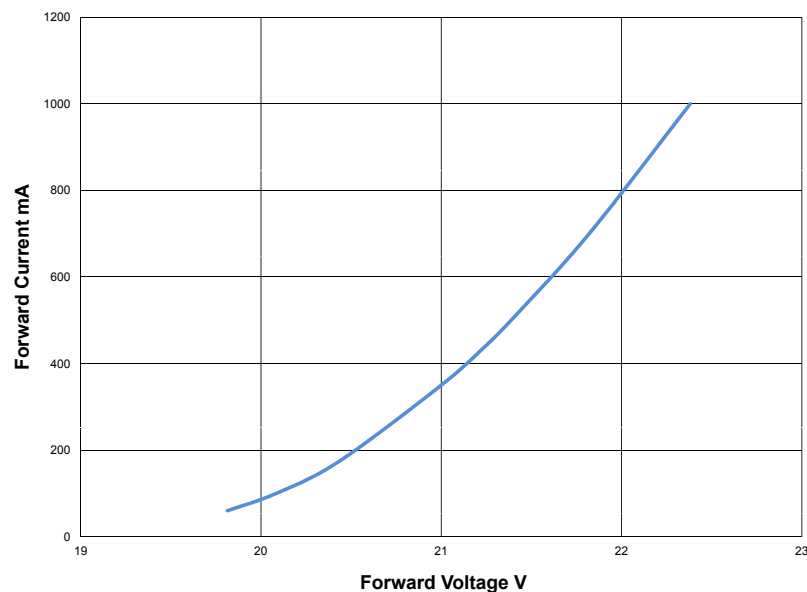


Figure 10. Forward current vs. forward voltage for LXXK8-PW27-0008, LXXK8-PW30-0008, LXXK8-PW35-0008, LXXK8-PW40-0008, LXXK8-PW50-0008 8-up products.

Typical Forward Current vs. Forward Voltage LUXEON K I2-up Products, Junction Temperature = 85°C

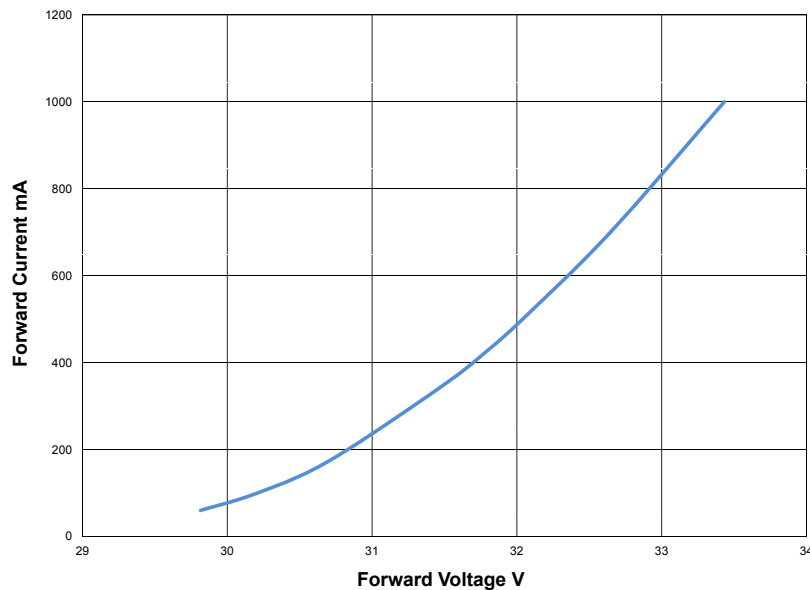


Figure 11. Forward current vs. forward voltage for LXX8-PW27-0012, LXX8-PW30-0012, LXX8-PW35-0012, LXX8-PW40-0012, LXX8-PW50-0012 I2-up products.

Typical Forward Current vs. Forward Voltage LUXEON K I6-up Products, Junction Temperature = 85°C

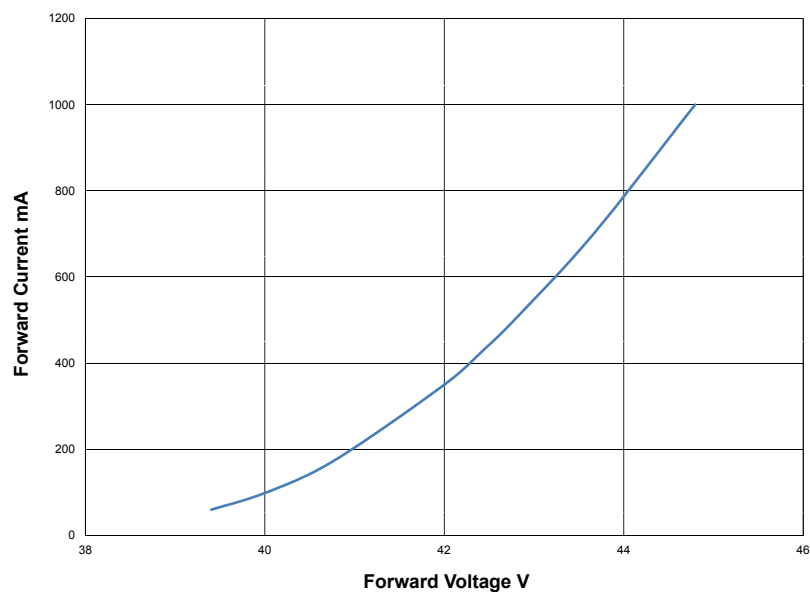


Figure 12. Forward current vs. forward voltage for LXX8-PW27-0016, LXX8-PW30-0016, LXX8-PW35-0016, LXX8-PW40-0016, LXX8-PW50-0016 I6-up products.

Typical Forward Current vs. Forward Voltage LUXEON K 24-up Products, Junction Temperature = 85°C

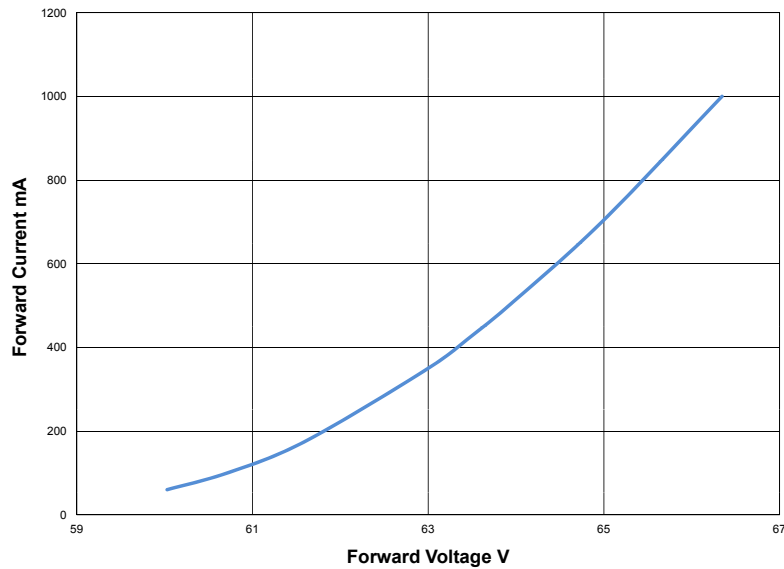


Figure 13. Forward current vs. forward voltage for LXX8-PW27-0024, LXX8-PW30-0024, LXX8-PW35-0024, LXX8-PW40-0024, LXX8-PW50-0024 24-up products.

Typical Relative Luminous Flux vs. Forward Current for All LUXEON K Products at Junction Temperature 85°C

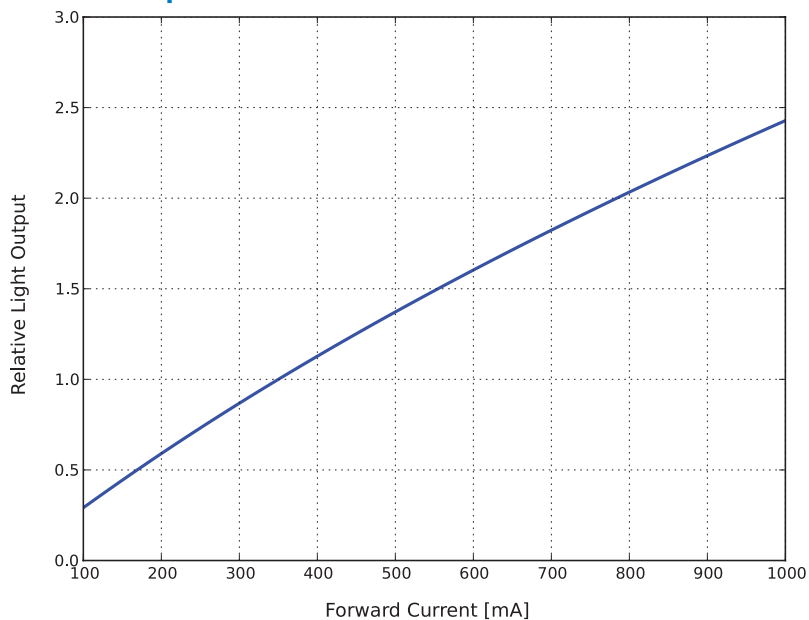


Figure 14. Typical relative luminous flux vs. forward current, junction temperature = 85°C.

Current Derating Curves

Current Derating Curve for IA Drive Current for 4-up

LXK8-PW27-0004, LXK8-PW30-0004, LXK8-PW35-0004, LXK8-PW40-0004, LXK8-PW50-0004

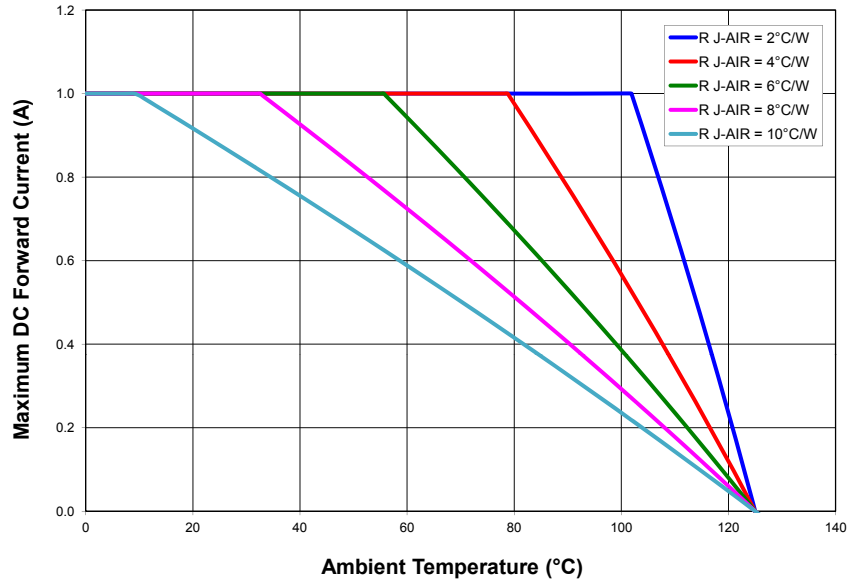


Figure 15. Maximum forward current vs. ambient temperature, based on $T_{JMAX} = 125^{\circ}\text{C}$.

Current Derating Curve for IA Drive Current for 8-up

LXK8-PW27-0008, LXK8-PW30-0008, LXK8-PW35-0008, LXK8-PW40-0008, LXK8-PW50-0008

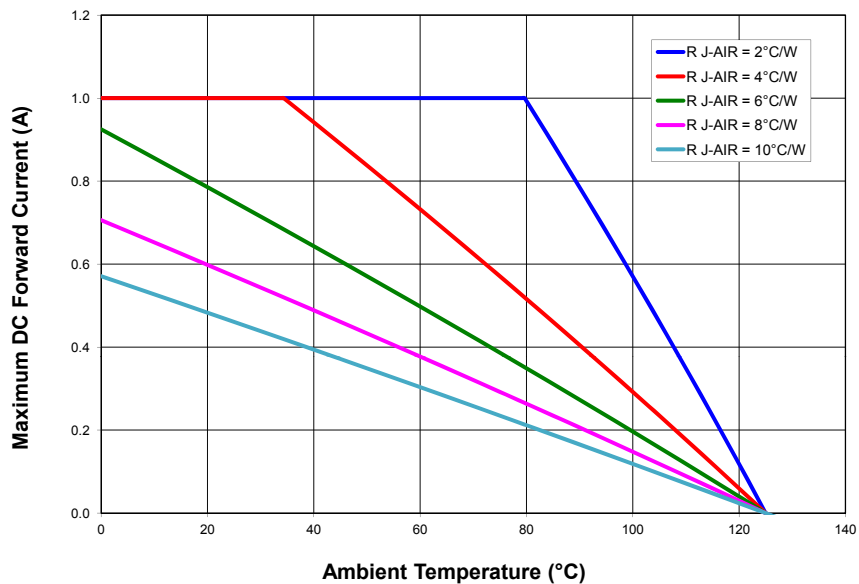


Figure 16. Maximum forward current vs. ambient temperature, based on $T_{JMAX} = 125^{\circ}\text{C}$.

Current Derating Curve for IA Drive Current for I2-up

LXK8-PW27-00I2, LXK8-PW30-00I2, LXK8-PW35-00I2, LXK8-PW40-00I2, LXK8-PW50-00I

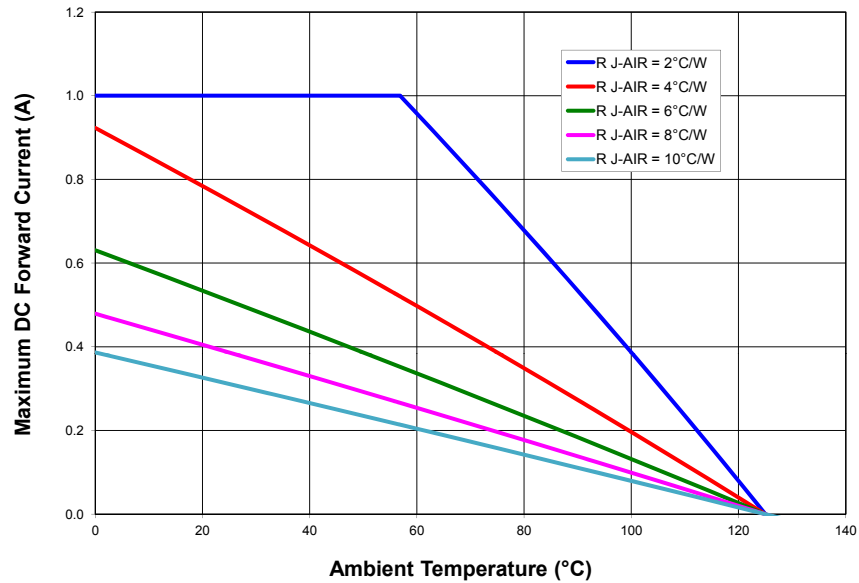


Figure 17. Maximum forward current vs. ambient temperature, based on $T_{JMAX} = 125^{\circ}\text{C}$.

Current Derating Curve for IA Drive Current for I6-up

LXK8-PW27-00I6, LXK8-PW30-00I6, LXK8-PW35-00I6, LXK8-PW40-00I6, LXK8-PW50-00I6

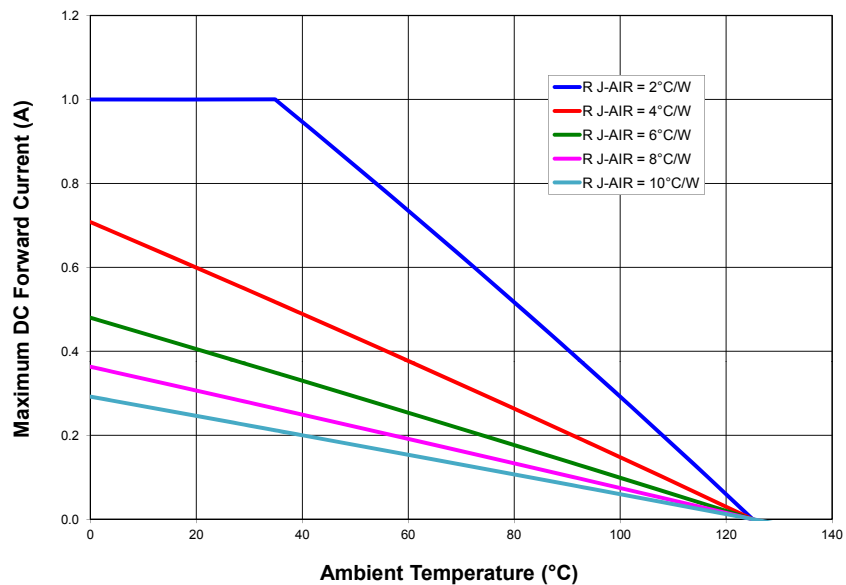


Figure 18. Maximum forward current vs. ambient temperature, based on $T_{JMAX} = 125^{\circ}\text{C}$.

Current Derating Curve for IA Drive Current for 24-up

LXK8-PW27-0024, LXK8-PW30-0024, LXK8-PW35-0024, LXK8-PW40-0024, LXK8-PW50-0024

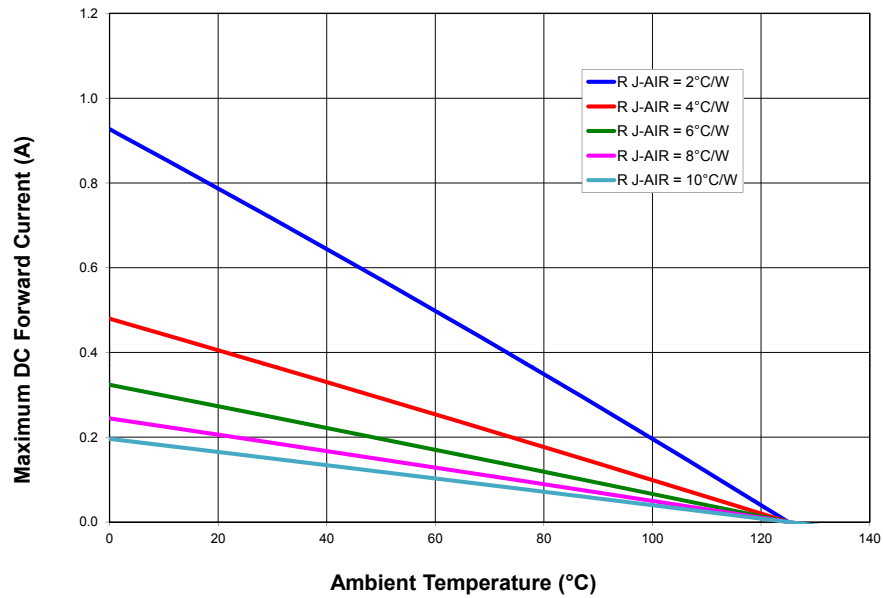


Figure 19. Maximum forward current vs. ambient temperature, based on $T_{JMAX} = 125^{\circ}\text{C}$.

Typical Radiation Patterns

Typical Spatial Radiation Pattern for LUXEON K

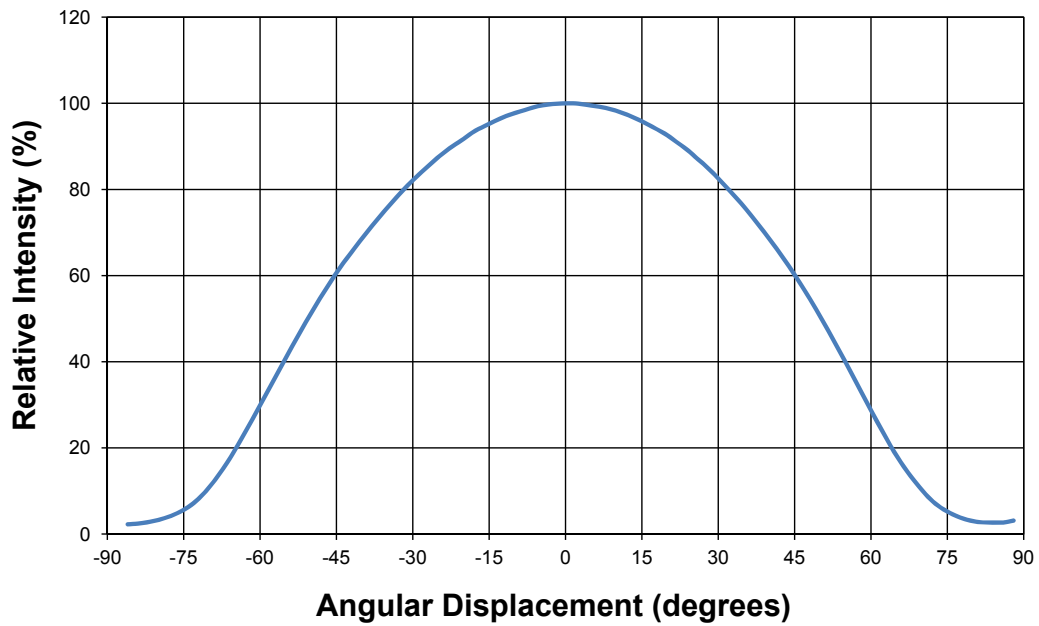


Figure 20. Typical representative spatial radiation pattern for LUXEON K.

Packaging on Trays

LUXEON K products will be securely packaged in trays.

Table 8.

Part Number	Tray Dimensions	Quantity per Tray	Number of Trays per Box
LXKx-Pxxx-0x04	315mm width x 135.9mm length x 12.11mm depth	40	10
LXKx-Pxxx-0x08	315mm width x 135.9mm length x 12.11mm depth	27	10
LXKx-Pxxx-0x12	315mm width x 135.9mm length x 12.11mm depth	24	10
LXKx-Pxxx-0x16	315mm width x 135.9mm length x 12.11mm depth	24	10
LXKx-Pxxx-0x24	315mm width x 135.9mm length x 12.11mm depth	21	10

Tray Dimensions – LXXx-Pxxx-0x04

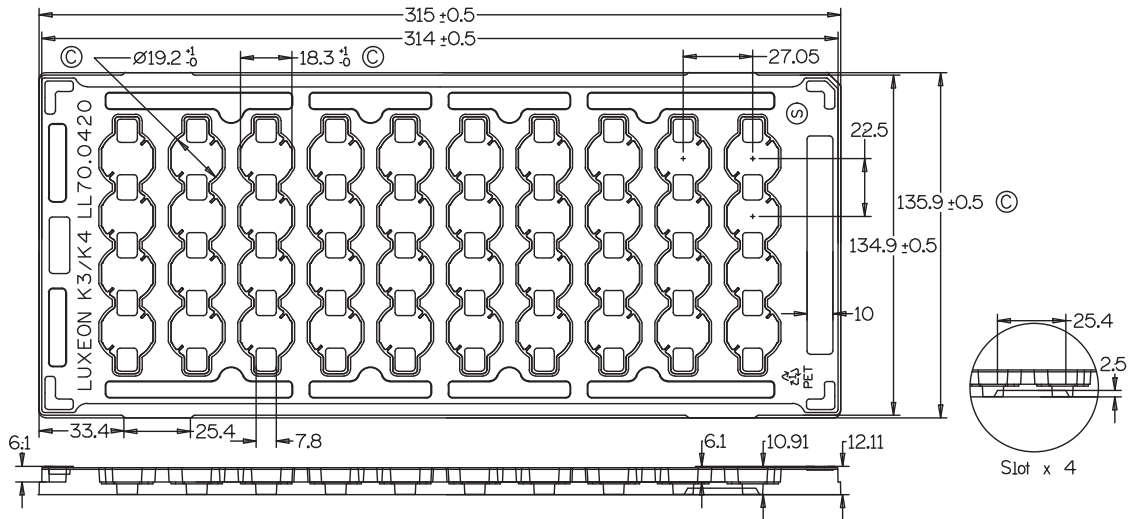


Figure 21.

Tray Dimensions – LXXx-Pxxx-0x08

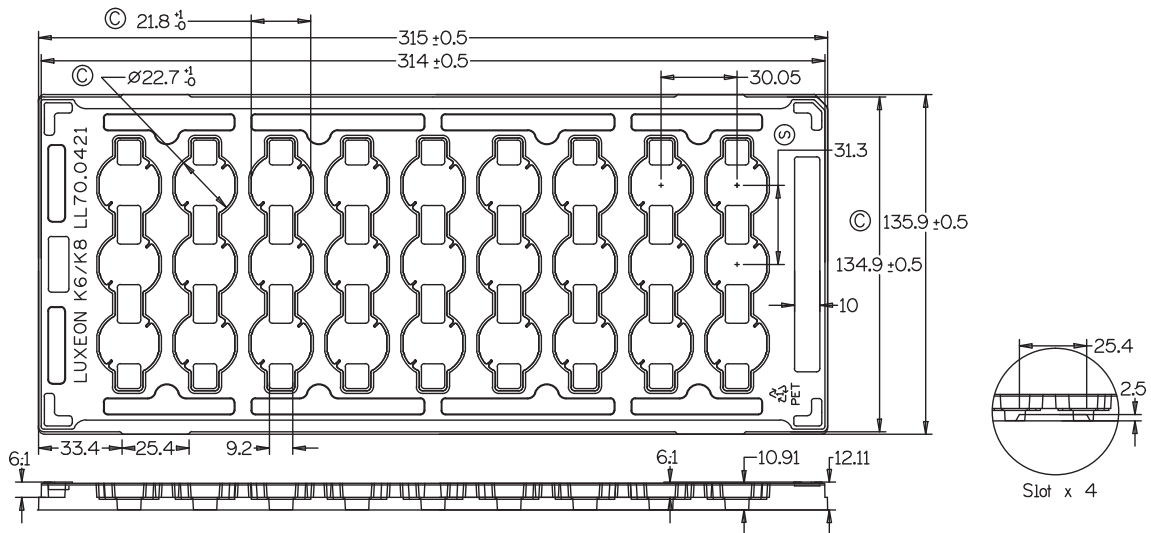


Figure 22.

Tray Dimensions – LXXx-Pxxx-0x12 and LXXx-Pxxx-0x16

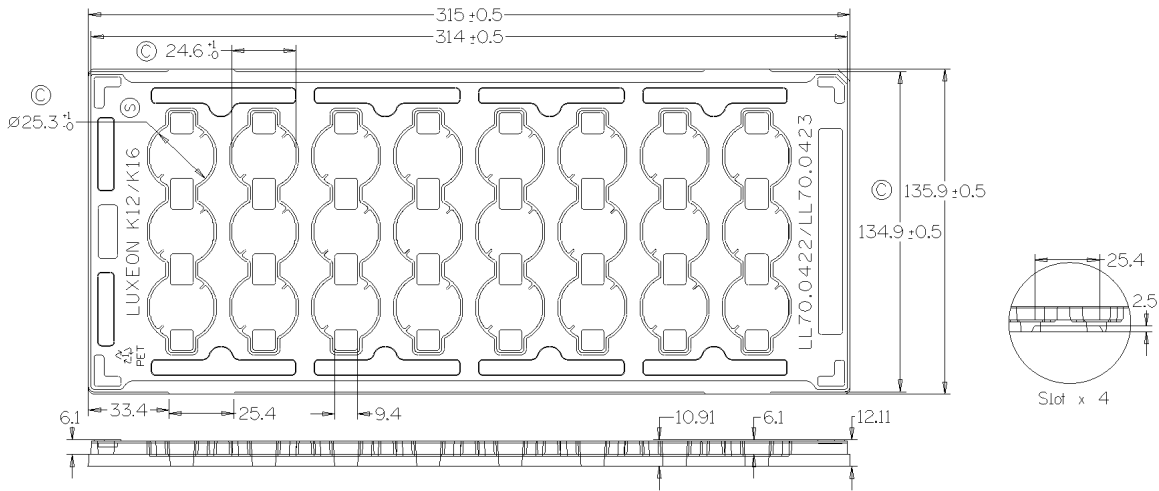


Figure 23.

Tray Dimensions – LXXx-Pxxx-0x24

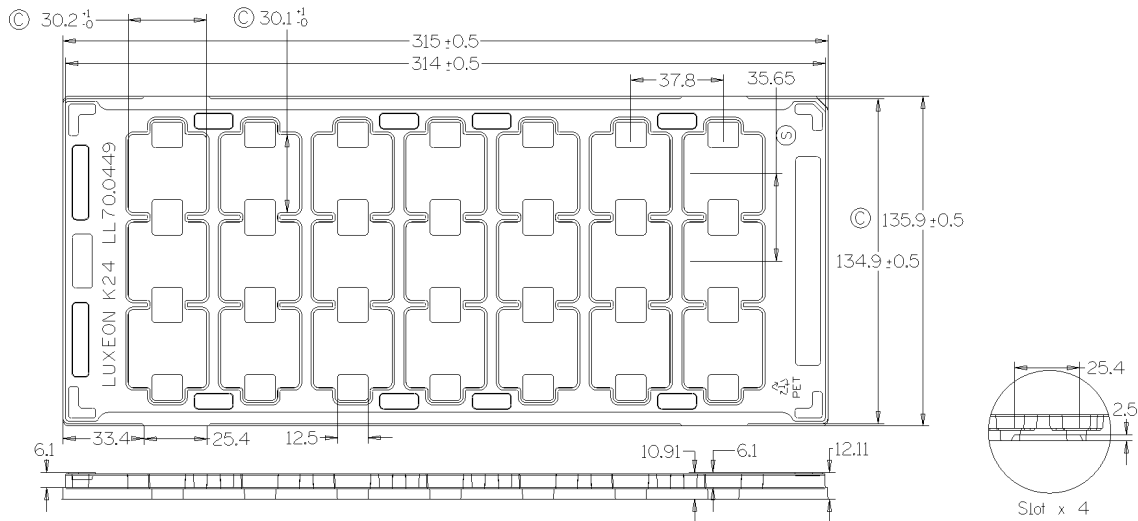


Figure 24.

LUXEON K White ANSI Color Bin Definition

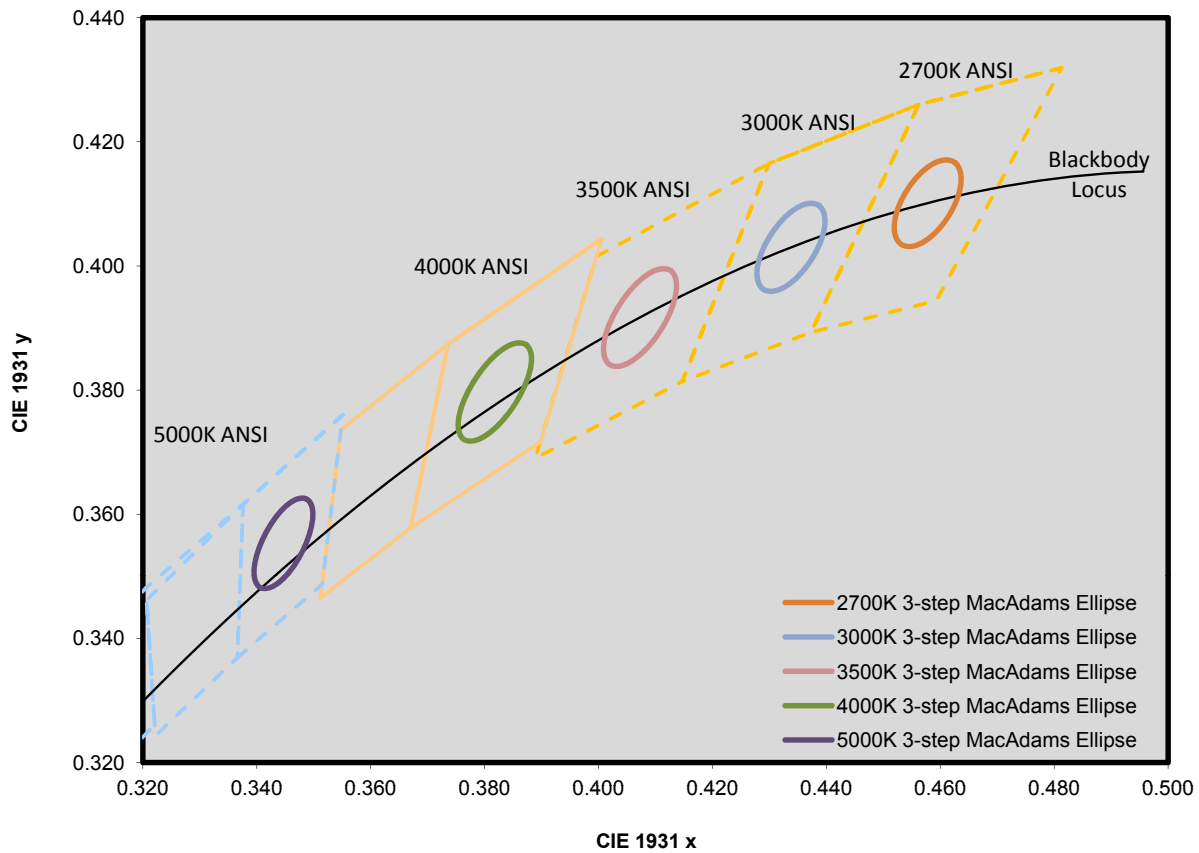


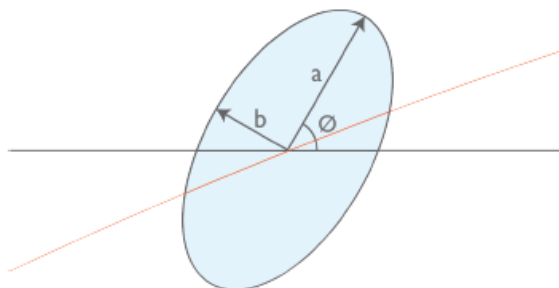
Figure 25.

Table 9. LUXEON K 3-step MacAdams Ellipse Color Definition

Nominal ANSI CCT	2700K	3000K	3500K	4000K	5000K
Color Space	Single 3-step MacAdam ellipse	Single 3-step MacAdam ellipse	Single 3-step MacAdam ellipse	Single 3-step MacAdam ellipse	Single 3-step MacAdam ellipse
Center Point (cx, cy)[1]	(0.4578, 0.4101)	(0.4338, 0.4030)	(0.4073, 0.3917)	(0.3818, 0.3797)	(0.3447, 0.3553)
Major Axis, a	0.0081	0.00834	0.00927	0.00939	0.00822
Minor Axis, b	0.0042	0.00408	0.00414	0.00402	0.00354
Ellipse rotation angle	53.7°	53.22°	54.00°	53.72°	59.62°

Note for Table 9:

- I. Philips Lumileds maintains a tester tolerance of ± 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 CO₂ emissions and reduce the need for power plant expansion. Philips Lumileds LUXEON® LEDs are enabling never before possible applications in outdoor lighting, shop lighting, home lighting, consumer electronics, and automotive lighting.

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

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