LUXEON 3535 2D Mid-Power LEDs

Illumination Portfolio

Introduction

The LUXEON® 3535 Mid-Power 2D LED portfolio in this datasheet delivers optimized performance in combination with Quality of Light needed for distributed light source applications. In addition to delivering specified Correlated Color Temperature and Color Rendering combinations, these emitters deliver the efficacy and reliability required by the indoor and outdoor illumination markets. This document contains the performance data needed to design and engineer applications based on these LUXEON 3535 2D Mid-Power emitters.

Features and Benefits

- High efficacy for sustainable design
- Compact 3535 2D package
- Minimum 80 CRI and R9 > 0 for quality indoor lighting
- ANSI compliant 1/6th color binning

Key Applications

- Architecture
- Downlight
- High Bay & Low Bay
- Indoor
- Lamps
- Outdoor
- Specialty
- Spotlight

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General Information

Product Nomenclature

LUXEON Mid-Power Illumination emitters are tested and binned at 100 mA, with current pulse duration of 20 ms. All characteristic charts where the thermal pad is kept at constant temperature (25°C typically) are measured with current pulse duration of 20 ms. Under these conditions, junction temperature and thermal pad temperature are the same.

The part number designations for the MXCA series is explained as follows:

M X C A - B C D E - I J K L

Where:

A — designates minimum CRI performance (value 7 = 70 minimum and 8 = 80 minimum)

B — designates radiation pattern (value P = Lambertian)

C — designates color (value W = White)

D, E — designates nominal ANSI CCT (for example, 30 = 3000K and 40 = 4000K)

I, J, K & L — additional part number designation

Therefore products in this series with minimum CRI value of 80, CCT of 4000K will have the part numbering scheme:

M X C 8 - P W 4 0 - 0 0 0 0

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. LM-80 test reports are available upon request.

Environmental Compliance

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

Product Selection

Product Selection for Mid-Power LEDs
Solder Pad Temperature = 25°C, Test Current = 100 mA

Table 1.

Nominal CCT	Part Number	Minimum CRI	Typical CRI	R9	Min Luminous Flux (lm) ϕ_V	Typ Luminous Flux (lm) ϕ_V
2700K	MXC8-PW27-0000	80	82	R9>0	55	66
	MXC9-PW27-0000	90	92	R9>50	50	55
3000K	MXC8-PW30-0000	80	82	R9>0	55	68
	MXC9-PW30-0000	90	92	R9>50	50	60
3500K	MXC8-PW35-0000	80	82	R9>0	55	69
	MXC9-PW35-0000	85	90	typ 50	50	62
4000K	MXC7-PW40-0000	70	72	-	70	77
	MXC8-PW40-0000	80	82	R>0	60	73
	MXC9-PW40-0000	85	90	typ 50	55	65
5000K	MXC7-PW50-0000	70	72	-	70	77
	MXC8-PW50-0000	80	82	R>0	60	75
5700K	MXC7-PW57-0000	70	72	-	70	77
	MXC8-PW57-0000	80	82	R>0	60	73
6500K	MXC7-PW65-0000	70	72	-	70	77
	MXC8-PW65-0000	80	82	R9>0	60	73

Note for Table 1:

1. Philips Lumileds maintains a tolerance of ± 7.5% on luminous flux and ± 2 on CRI measurements.

Optical Characteristics

Optical Characteristics of Mid-Power LEDs
Solder Pad Temperature = 25°C, Test Current = 100 mA

Table 2.

Nominal CCT	Color Temperature CCT			Typical Total Included Angle [1] (degrees) $\theta_{0.90V}$	Typical Viewing Angle [2] (degrees) 2θ ½
	Minimum	Typical	Maximum		
2700K	2550K	2700K	2850K	150	115
3000K	2850K	3000K	3200K	150	115
3500K	3200K	3500K	3750K	150	115
4000K	3750K	4000K	4250K	150	115
5000K	4700K	5000K	5300K	150	115
5700K	5300K	5700K	6000K	150	115
6500K	6000K	6500K	7000K	150	115

Notes for Table 2:

1. Total angle at which 90% of total luminous flux is captured.
2. Viewing angle is the off axis angle from lamp centerline where the luminous intensity is ½ of the peak value.

Electrical Characteristics

Electrical Characteristics of Mid-Power LEDs
Thermal Pad Temperature = 25°C, Test Current = 100 mA

Table 3.

Part Number	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 Solder Pad (°C/W) $R\theta_{J-C}$
	Minimum	Typical	Maximum		
MXCx-PWxx-0000	5.6	6.1	6.8	-2.0 to -4.0	18

Notes for Table 3:

1. Philips Lumileds maintains a tolerance of ±0.10V on forward voltage measurements.
2. Measured at T_j between 25°C and 110°C.

Absolute Maximum Ratings

Table 4.

Parameter	Maximum Performance
DC Forward Current (mA) [1]	200
Peak Pulsed Forward Current (mA)	200
ESD Sensitivity	Class 3A Human Body Model Class C Machine Model
LED Junction Temperature [2]	125°C
Operating Case Temperature at 100 mA	-40°C - 105°C
Storage Temperature	-40°C - 105°C
Soldering Temperature	JEDEC 020D 260°C
Allowable Reflow Cycles	3
Reverse Voltage (Vr) [3], [4]	-5V

Notes for Table 4:

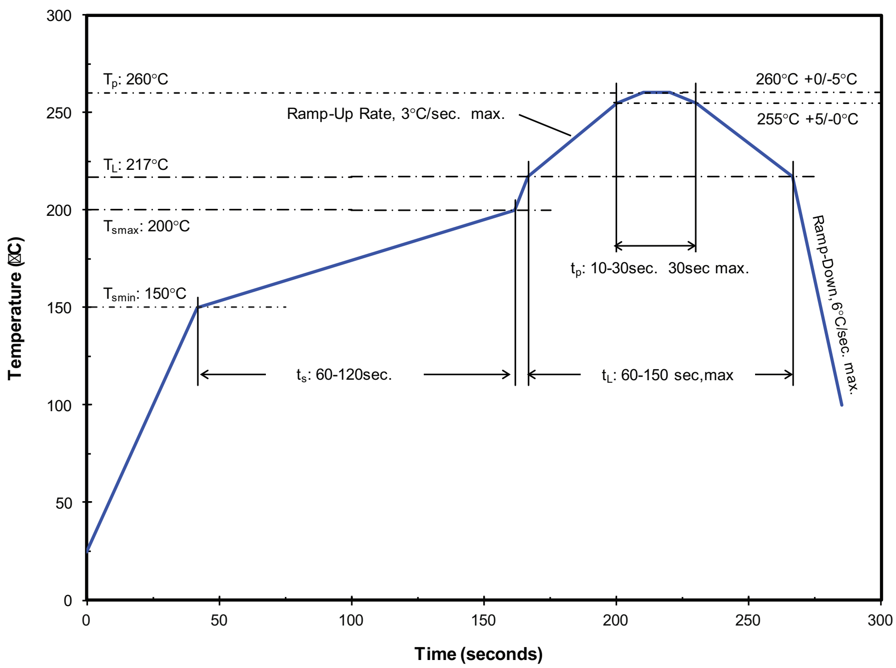
1. Ripple current with a frequency of 50-150 Hz is allowed, as long as the average of the current waveform is below 200 mA, and the maximum of the current waveform is lower than 200 mA.
2. Proper current derating must be observed to maintain junction temperature below the maximum.
3. LUXEON Mid-Power LEDs are not designed to be driven in reverse bias.
4. At maximum reverse current of 10 µA.

JEDEC Moisture Sensitivity

Table 5.

Level	Floor Life		Soak Requirements Standard	
	Time	Conditions	Time	Conditions
2	1 year	≤ 30°C / 60% RH	168 Hrs. + 5 / - 0 Hrs.	≤85°C / 60% RH

Reflow Soldering Characteristics



Temperature profile for Table 6.

Table 6. Reflow Profile in Accordance with J-Std-020D.

Profile Feature	Lead Free Assembly
Preheat/Soak : Temperature Min (T_{smin}) Temperature Max (T_{smax}) Maximum Time (t_s) from T_{smin} to T_{smax}	 150°C 200°C 120 seconds
Ramp-up Rate (T_L to T_p)	3°C / second
Liquidous Temperature (T_L)	217°C
Maximum Time (t_L) Maintained above T_L	150 seconds
Maximum Peak Package Body Temperature (T_p)	260°C
Time (t_p) within 5°C of the specified temperature (T_c)	10-30 seconds
Maximum Ramp-Down Rate (T_p to T_L)	6°C / second
Maximum Time 25°C to Peak Temperature	8 minutes

Note for Table 6:

1. All temperatures refer to the application Printed Circuit Board (PCB), measured on the surface adjacent to the package body.

Mechanical Dimensions

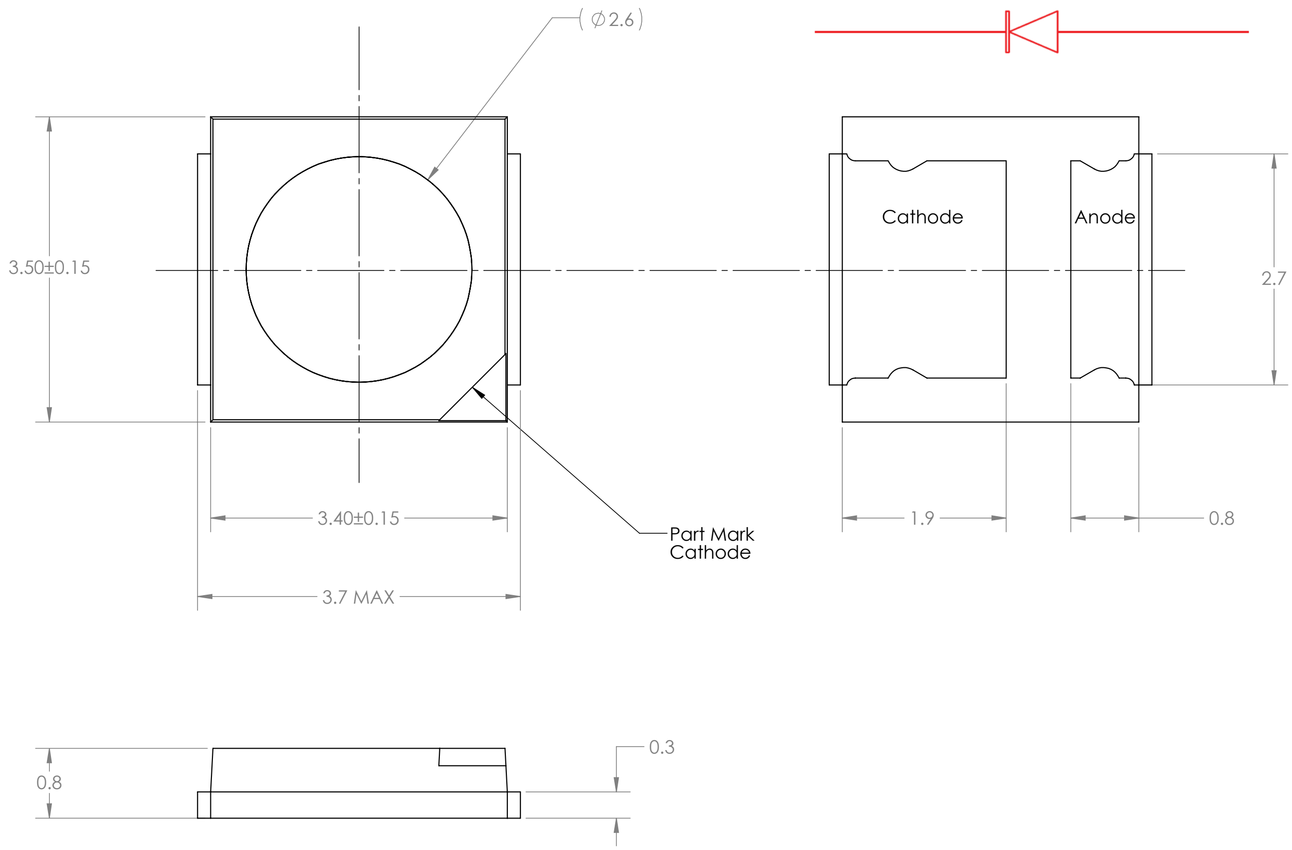


Figure 1. Package outline drawing.

Notes for Figure 1:

1. All dimensions are in millimeters.
2. Tolerance: ±0.10mm.
3. Materials
    - Lead Frame: Copper Alloy with Silver Plating
    - Package Body: High Temperature Thermal Plastic
    - Encapsulant: Silicone Resin
    - Solder Lead Finish: Sn-Sn Plating

Solder Pad Design

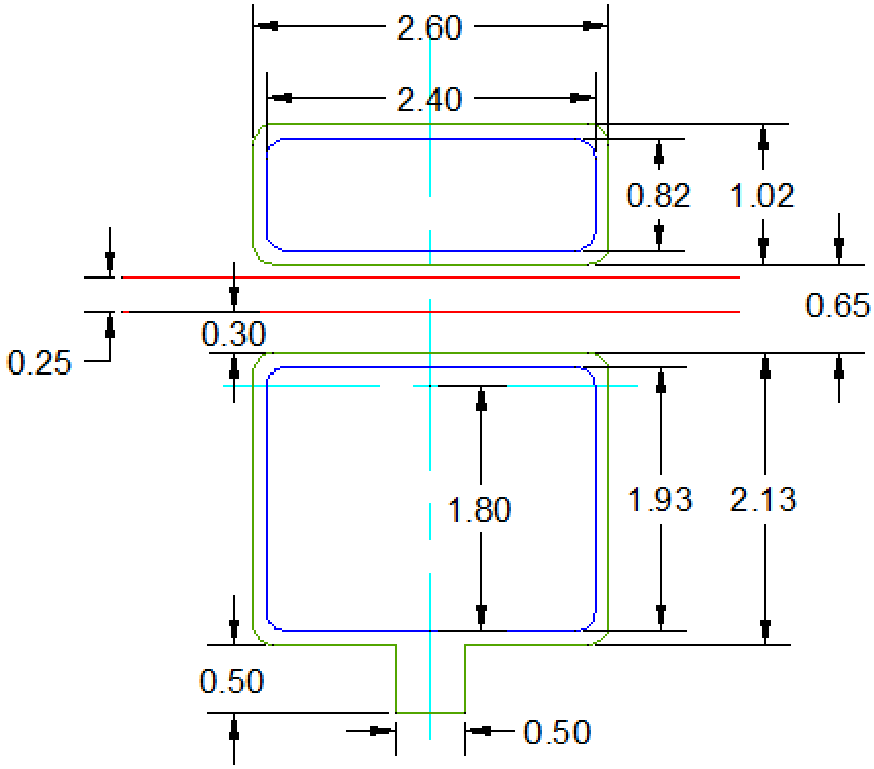


Figure 2. Solder pad layout.

Notes for Figure 2:

1. The drawing above shows the recommended solder pad layout on Printed Circuit Board (PCB).
2. Application Brief AB204 (to be released) provides extensive details for this layout. In addition, the .dwg files are available at www.philipslumileds.com and www.philipslumileds.cn.com.

Assembly Precautions

The LUXEON emitter package contains a silicone overcoat to protect the LED chip and extract the maximum amount of light. As with most silicones used in LED optics, care must be taken to prevent any incompatible chemicals from directly or indirectly reacting with the silicone.

The silicone overcoat used in the LUXEON emitter is gas permeable. Consequently, oxygen and volatile organic compound (VOC) gas molecules can diffuse into the silicone overcoat. VOCs may originate from adhesives, solder fluxes, conformal coating materials, potting materials and even some of the inks that are used to print the PCBs.

Some VOCs and chemicals react with silicone and produce discoloration and surface damage. Other VOCs do not chemically react with the silicone material directly but diffuse into the silicone and oxidize during the presence of heat or light. Regardless of the physical mechanism, both cases may affect the total LED light output. Since silicone permeability increases with temperature, more VOCs may diffuse into and/or evaporate out from the silicone.

Please refer to AB203 for more details on VOCs and other incompatible chemicals.

Relative Spectral Distribution

Relative Intensity vs. Wavelength, MXC7-PWxx

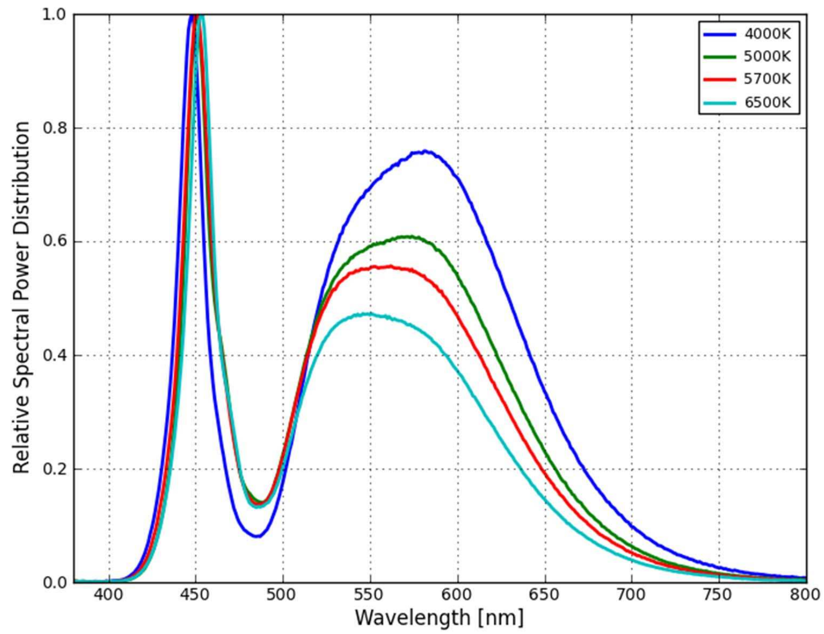


Figure 3a. Typical color spectrum of MXC7-PWxx emitter, integrated measurement at solder pad temperature = 25°C, forward current = 100 mA.

Relative Intensity vs. Wavelength, MXC8-PWxx

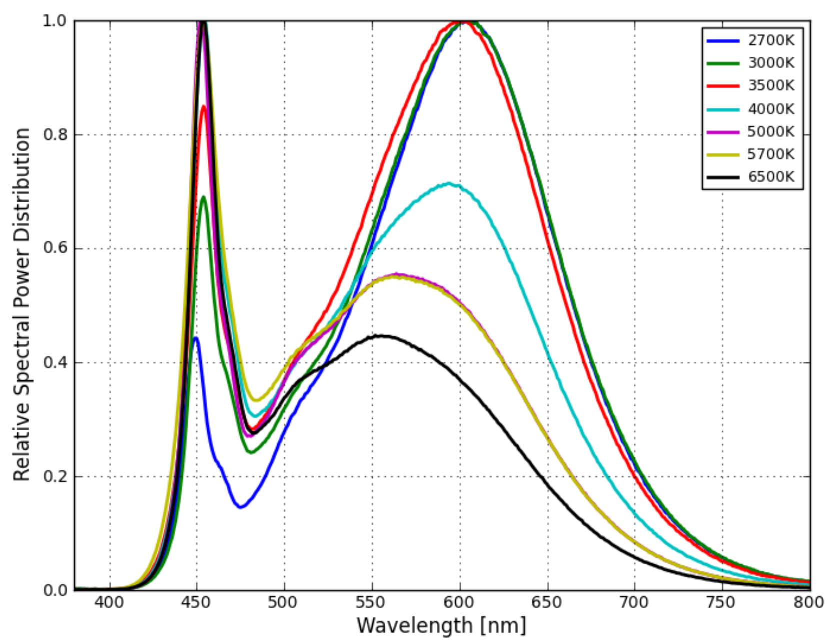


Figure 3b. Typical color spectrum of MXC8-PWxx emitter, integrated measurement at solder pad temperature = 25°C, forward current = 100 mA.

Relative Intensity vs. Wavelength, MXC9-PWxx

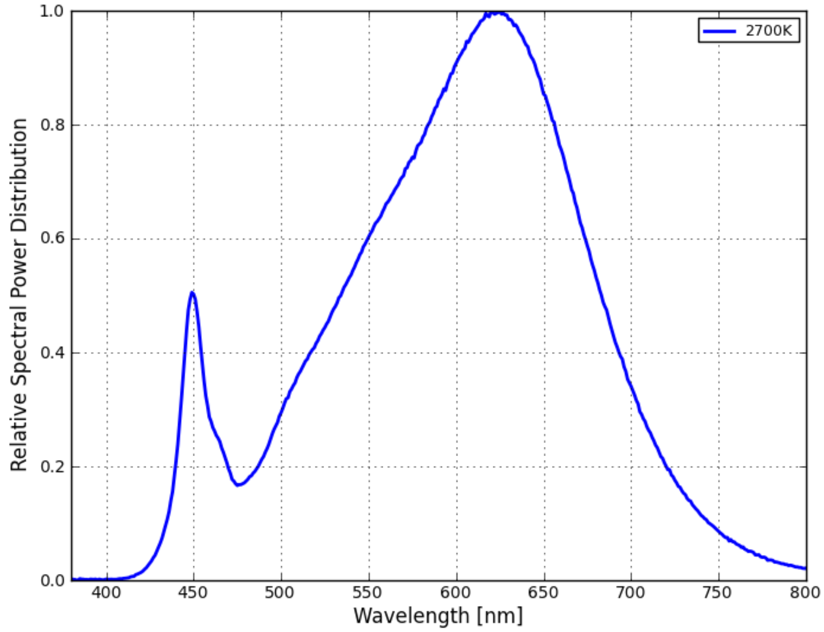


Figure 3c. Typical color spectrum of MXC9-PWxx emitter, integrated measurement at solder pad temperature = 25°C, forward current = 100 mA.

Light Output Characteristics

Relative Flux over Temperature
MXCx-PWxx

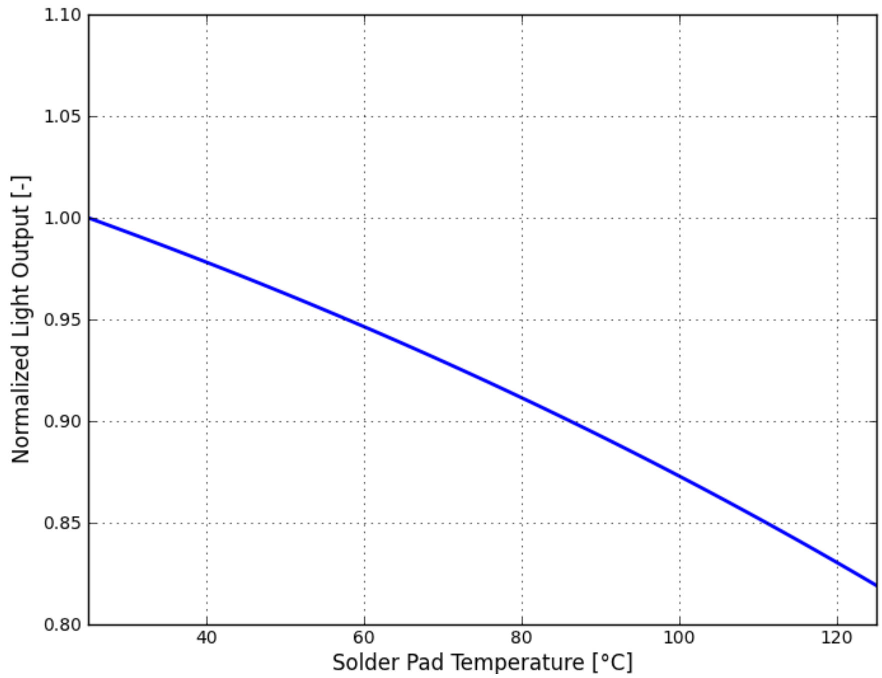


Figure 4. Typical relative light output vs. solder pad temperature, forward current = 100 mA.

Relative Flux vs. Forward Current
MXCx-PWxx

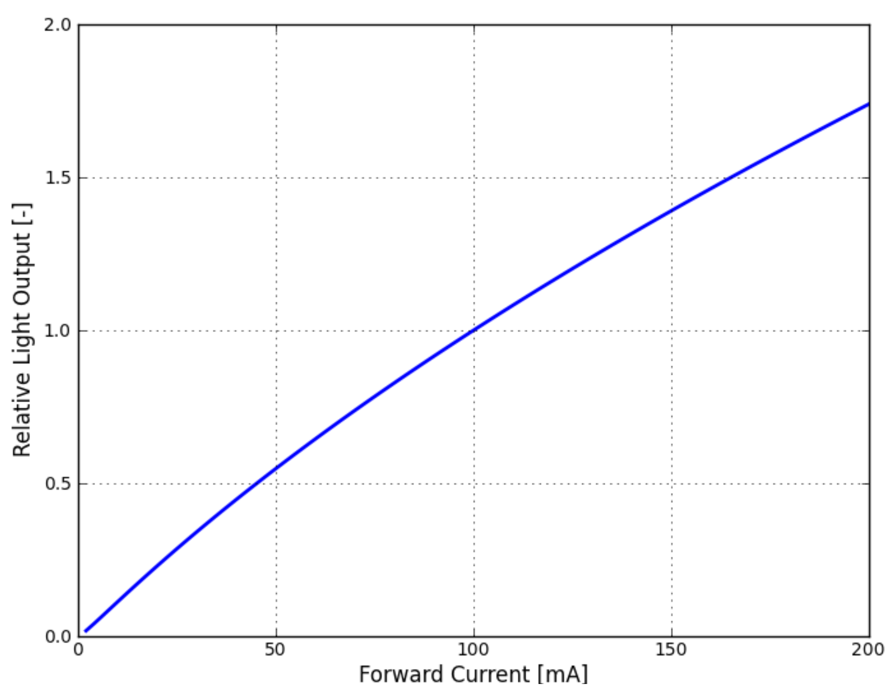


Figure 5. Typical relative luminous flux vs. forward current, solder pad temperature = 25°C.

Luminous Efficacy Characteristics

Relative Luminous Efficacy vs. Forward Current MXCx-PWxx

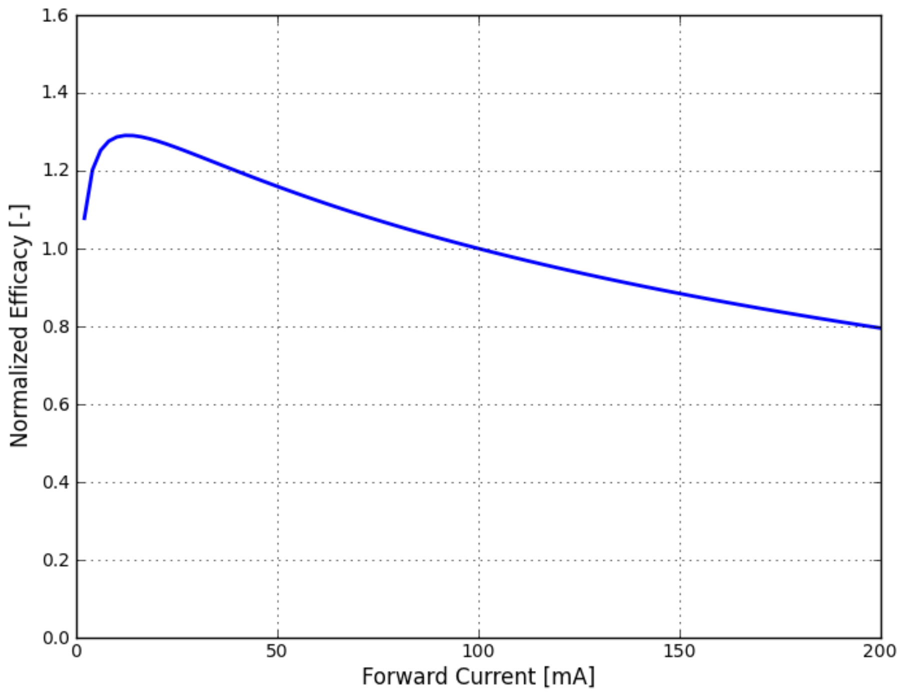


Figure 6. Typical emitter efficacy versus forward current, solder pad temperature = 25°C.

Forward Current Characteristics

Forward Current vs. Forward Voltage
MXCx-PWxx

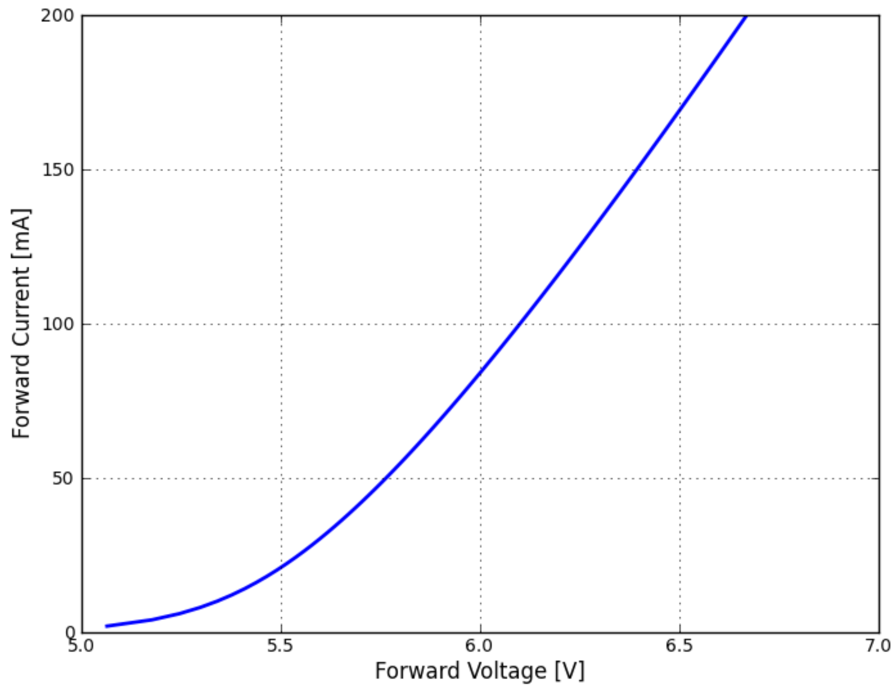


Figure 7. Typical forward current vs. forward voltage, solder pad temperature = 25°C.

Typical Radiation Patterns

Radiation Pattern in Cartesian Coordinate System

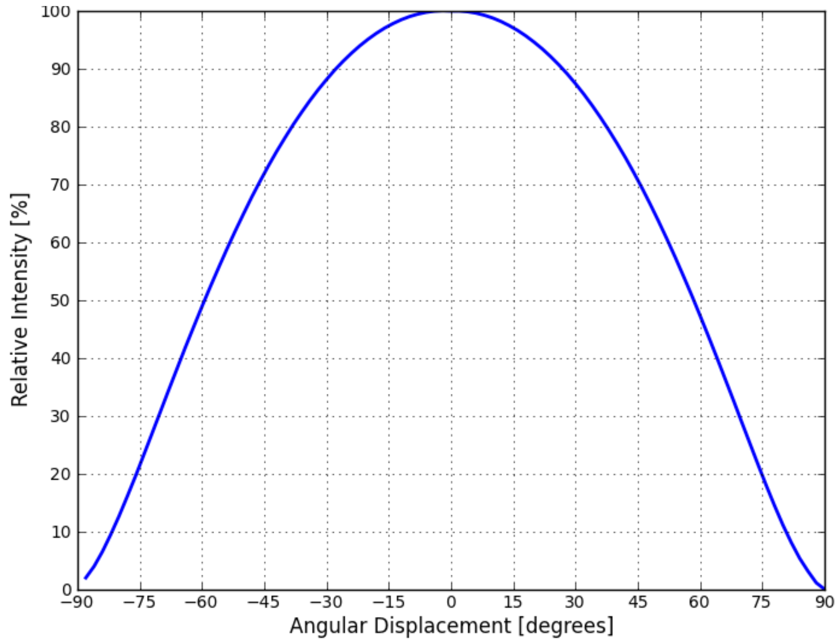


Figure 8. Typical representative spatial radiation pattern.

Radiation Pattern in Polar Coordinate System

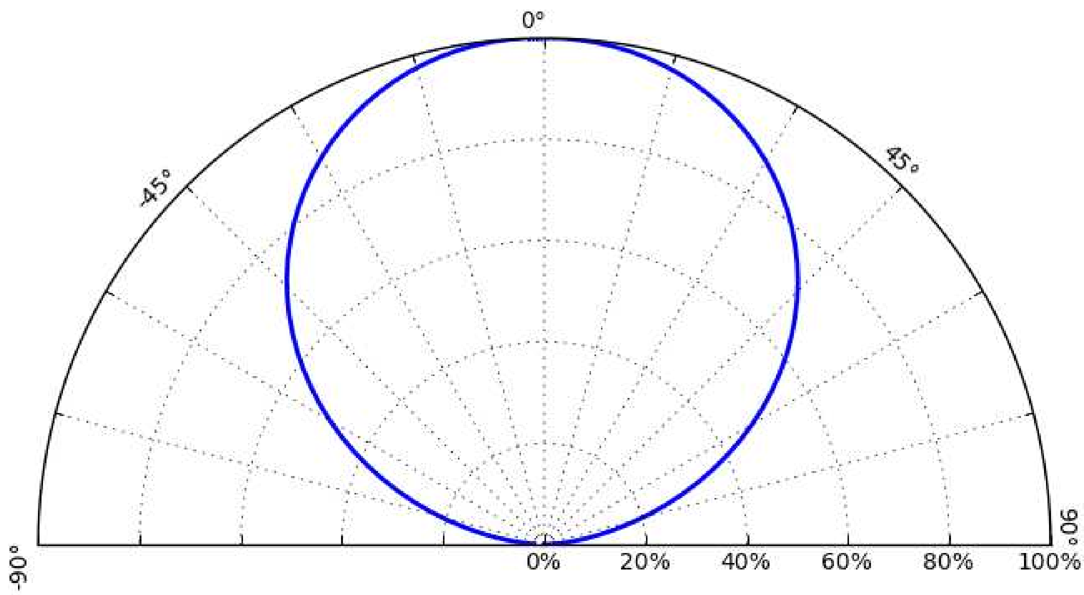


Figure 9. Typical polar plot of radiation pattern.

Emitter Pocket Tape Packaging

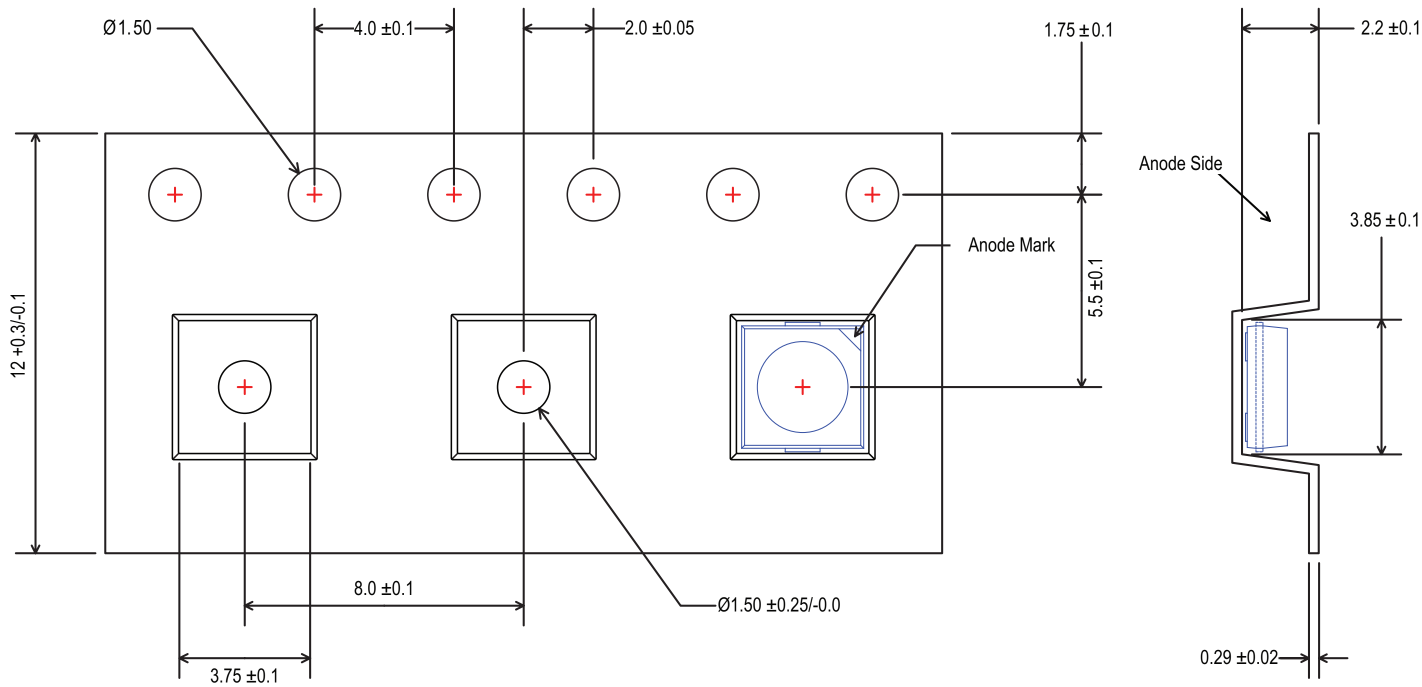


Figure 10. Emitter pocket tape packaging.

Notes for Figure 10:

1. All dimensions are in millimeters
2. Empty component pockets sealed with top cover tape
3. The maximum number of consecutive missing LEDs is two.

Emitter Reel Packaging

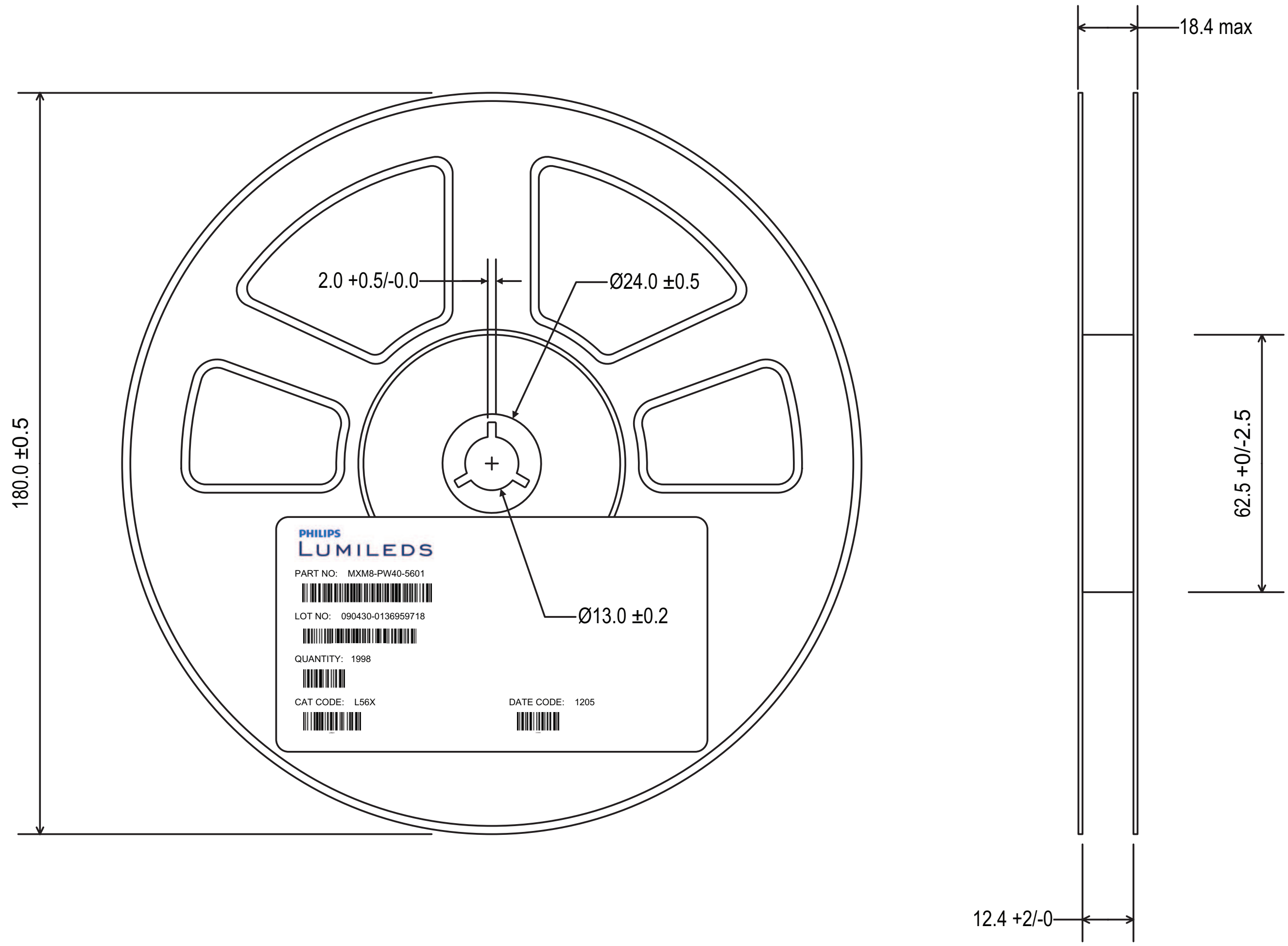


Figure 11. Emitter reel packaging.

Notes for Figure 11:

1. All dimentions are in millimeters.
2. Empty component pockets sealed with top cover tape.
3. 7 inch reel-1000 pieces per reel.
4. Minimum packing quantity is 500 pieces.
5. The maximum number of consecutive missing LEDs is two.
6. In accordance with EIA-481-1-B specification.

Product Binning and Labeling

Purpose of Product Binning

In the manufacturing of semiconductor products, there is a variation of performance around the average values given in the technical data sheets. For this reason, Philips Lumileds bins the LED components for luminous flux, color and forward voltage (V_f).

Decoding Product Bin Labeling

LUXEON Mid-Power 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. Using these codes, it is possible to determine optimum mixing and matching of products for consistency in a given application.

Reels of 2700K, 3000K, 3500K, 4000K, 5000K, 5700K and 6500K emitters are labeled with a four digit alphanumeric CAT code following the format below.

ABCD

A = Flux bin (D, etc.)

B and C = Color bin (For example 51, 52, 53, 54, 55, 56)

D = V_f bin

Luminous Flux Bins

Table 7 lists the standard photometric luminous flux bins for LUXEON Mid-Power emitters (tested and binned at 100 mA).

Although several bins are outlined, product availability in a particular bin varies by production run and by product performance. Not all bins are available in all colors.

Table 7. Flux Bins

Bin Code	Minimum Photometric Flux (lm)	Maximum Photometric Flux (lm)
A	55	60
B	60	65
C	65	70
D	70	75
E	75	80

Tested and binned at 25°C, If=100 mA. Tester tolerance: ±7.5%.

Forward Voltage Bins

Table 8. V_f Bins

Bin Code	Minimum Forward Voltage (V)	Maximum Forward Voltage (V)
F	5.6	5.8
G	5.8	6
H	6	6.2
J	6.2	6.4
K	6.4	6.6
L	6.6	6.8

Tested and binned at 25°C, If = 100 mA. Tester tolerance: ±0.10V

Color Bin Structure

MXCx-PW27-xxxx Color Bin Structure

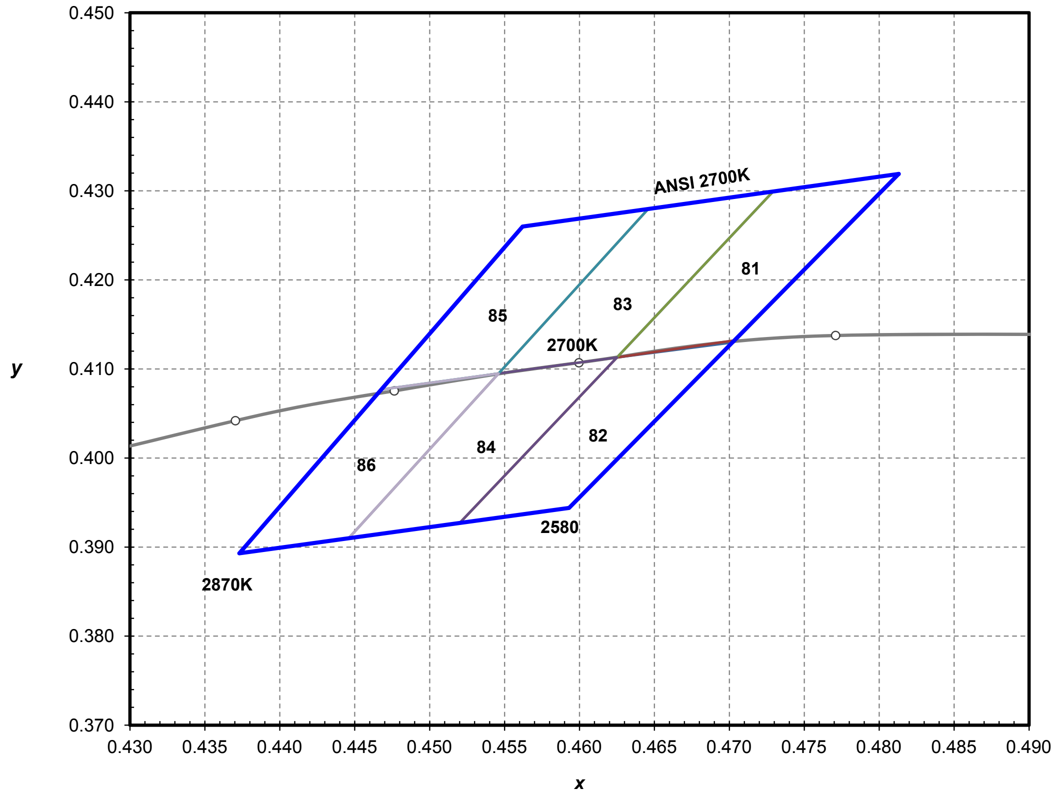


Figure 12. ANSI 2700K 1/6th color bin structure.

LUXEON Mid-Power Emitters are tested and binned by x,y coordinates.

Table 9.

LUXEON Mid-Power ANSI 1/6 Color Bin Coordinates for MXCx-PW27-xxxx Emitter					
Bin Code	x	y	Bin Code	x	y
81	0.4625 0.4729 0.4813 0.4703	0.4113 0.4299 0.4319 0.4132	84	0.4446 0.4546 0.4625 0.4520	0.3910 0.4095 0.4113 0.3927
82	0.4520 0.4625 0.4703 0.4593	0.3927 0.4113 0.4132 0.3944	85	0.4468 0.4562 0.4646 0.4546	0.4077 0.4260 0.4280 0.4095
83	0.4546 0.4646 0.4729 0.4625	0.4095 0.4280 0.4299 0.4113	86	0.4373 0.4468 0.4546 0.4446	0.3893 0.4077 0.4095 0.3910

Notes for Table 9:

1. Tested and binned at 25°C and If = 100 mA. Tester tolerance: +/- 0.01 in x and y coordinates

Color Bin Structure, Continued

MXCx-PW30-xxxxx Color Bin Structure

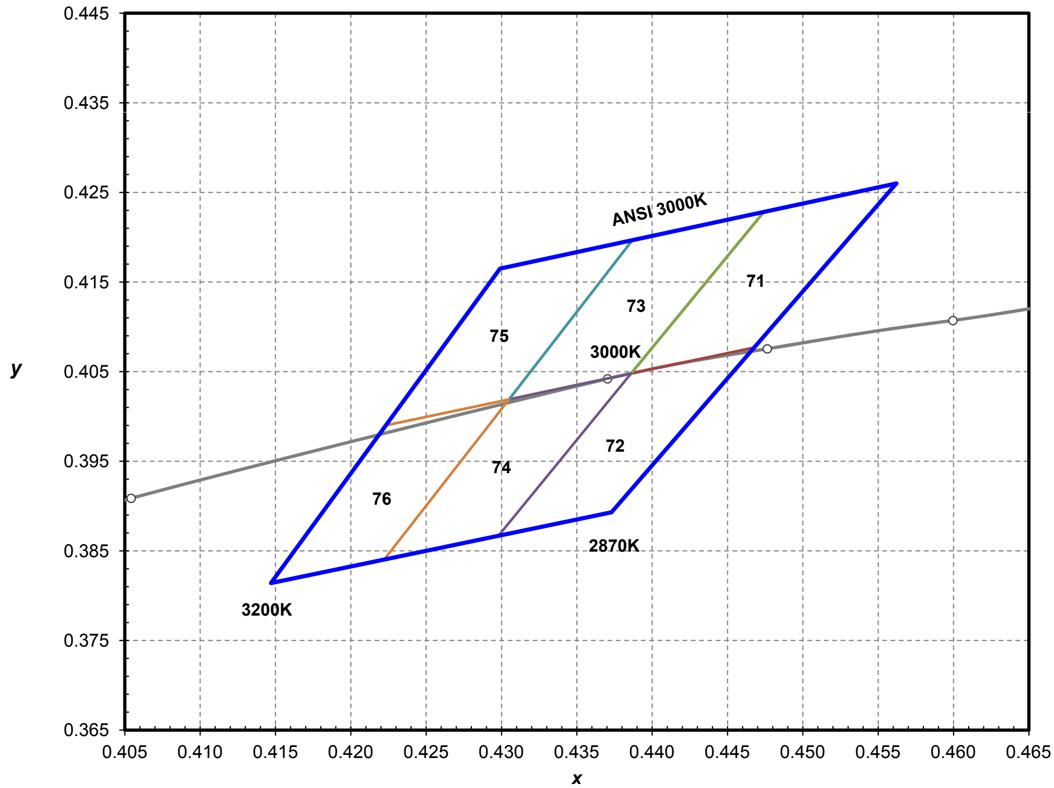


Figure 13. ANSI 3000K 1/6th color bin structure.

LUXEON Mid-Power Emitters are tested and binned by x,y coordinates.

Table 10.

LUXEON Mid-Power ANSI 1/6 Color Bin Coordinates for MXCx-PW30-xxxx Emitter					
Bin Code	x	y	Bin Code	x	y
71	0.4386 0.4474 0.4562 0.4468	0.4048 0.4228 0.4260 0.4077	74	0.4222 0.4305 0.4386 0.4298	0.3840 0.4019 0.4048 0.3867
72	0.4298 0.4386 0.4468 0.4373	0.3867 0.4048 0.4077 0.3893	75	0.4223 0.4299 0.4387 0.4305	0.3990 0.4165 0.4197 0.4019
73	0.4305 0.4387 0.4474 0.4386	0.4019 0.4197 0.4228 0.4048	76	0.4147 0.4223 0.4305 0.4222	0.3814 0.3990 0.4019 0.3840

Notes for Table 10:

1. Tested and binned at 25°C and If = 100 mA. Tester tolerance: +/- 0.01 in x and y coordinates

Color Bin Structure, Continued

MXCx-PW35-xxxxx Color Bin Structure

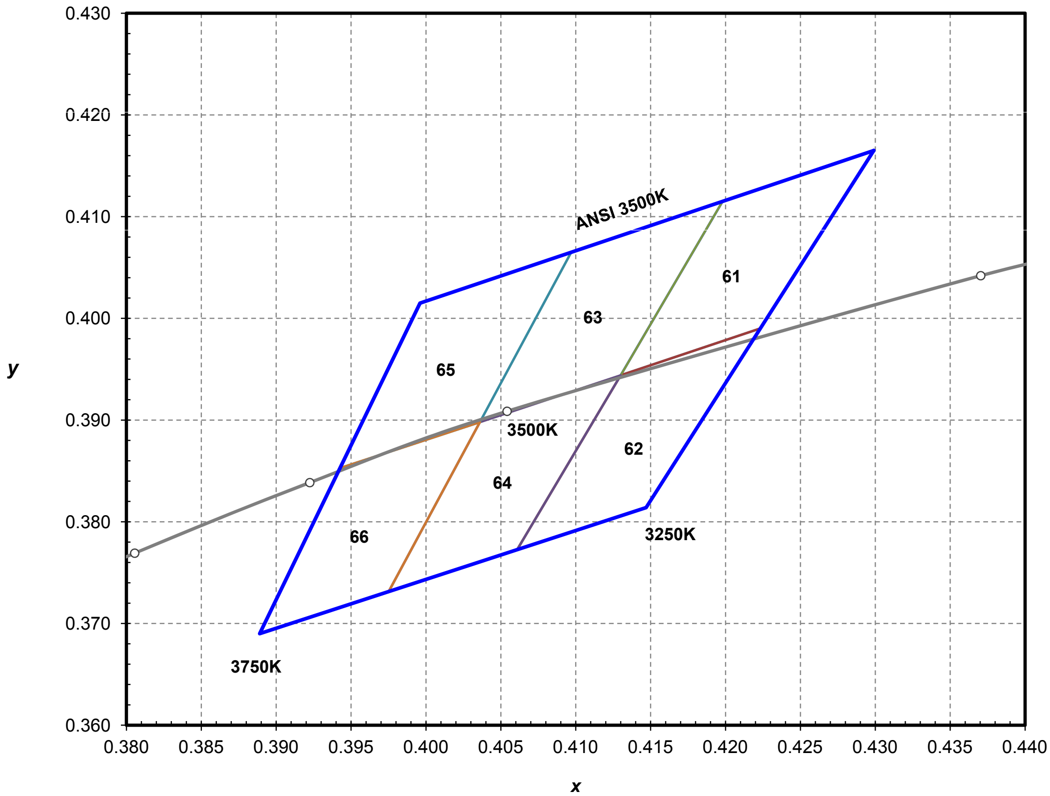


Figure 14. ANSI 3500K 1/6th color bin structure.

LUXEON Mid-Power Emitters are tested and binned by x,y coordinates.

Table 11.

LUXEON Mid-Power ANSI 1/6 Color Bin Coordinates for MXCx-PW35-xxxx Emitter					
Bin Code	x	y	Bin Code	x	y
61	0.4130 0.4198 0.4299 0.4223	0.3944 0.4115 0.4165 0.3990	64	0.3975 0.4036 0.4130 0.4061	0.3731 0.3898 0.3944 0.3773
62	0.4061 0.4130 0.4223 0.4147	0.3773 0.3944 0.3990 0.3814	65	0.3943 0.3996 0.4097 0.4036	0.3853 0.4015 0.4065 0.3898
63	0.4036 0.4097 0.4198 0.4130	0.3898 0.4065 0.4115 0.3944	66	0.3889 0.3943 0.4036 0.3975	0.3690 0.3853 0.3898 0.3731

Notes for Table 11:

1. Tested and binned at 25°C and If = 100 mA. Tester tolerance: +/- 0.01 in x and y coordinates

Color Bin Structure, Continued

MXCx-PW40-xxxx Color Bin Structure

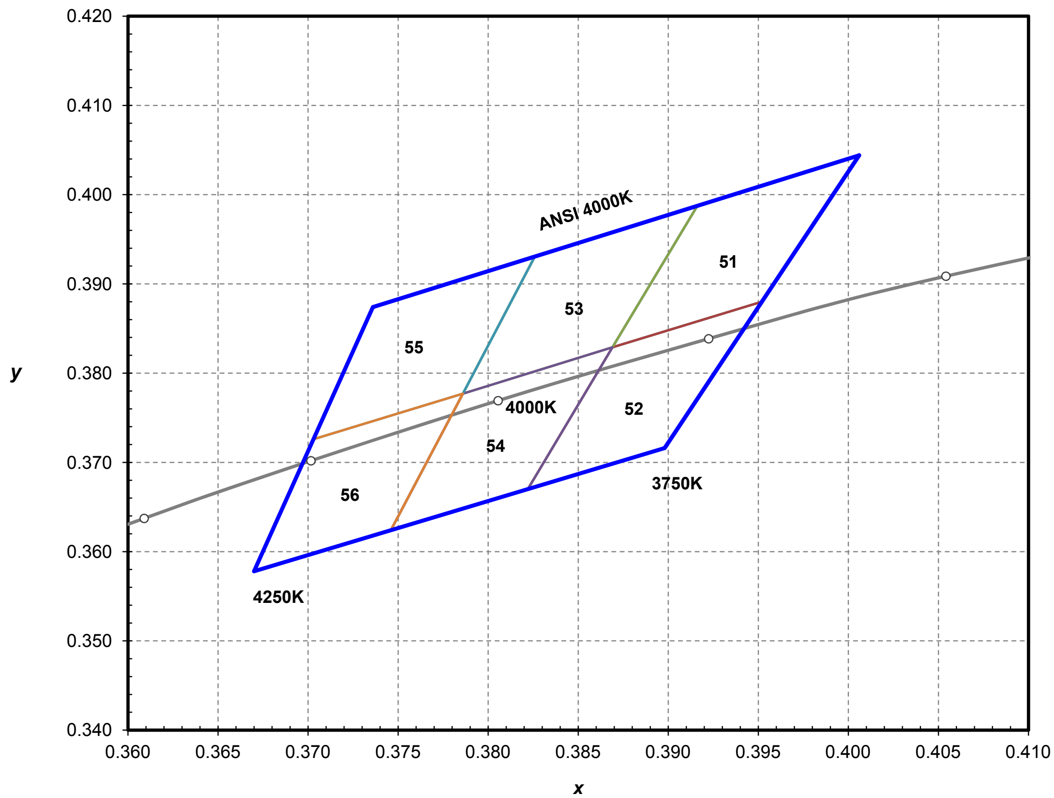


Figure 15. ANSI 4000K 1/6th color bin structure.

LUXEON Mid-Power Emitters are tested and binned by x,y coordinates.

Table 12.

LUXEON Mid-Power ANSI 1/6 Color Bin Coordinates for MXCx-PW40-xxxxx Emitter					
Bin Code	x	y	Bin Code	x	y
51	0.3869 0.3916 0.4006 0.3952	0.3829 0.3987 0.4044 0.3880	54	0.3746 0.3786 0.3869 0.3822	0.3624 0.3777 0.3829 0.3670
52	0.3822 0.3869 0.3952 0.3898	0.3670 0.3829 0.3880 0.3716	55	0.3703 0.3736 0.3826 0.3786	0.3726 0.3874 0.3931 0.3777
53	0.3786 0.3826 0.3916 0.3869	0.3777 0.3931 0.3987 0.3829	56	0.3670 0.3703 0.3786 0.3746	0.3578 0.3726 0.3777 0.3624

Notes for Table 12:

1. Tested and binned at 25°C and If = 100 mA. Tester tolerance: +/- 0.01 in x and y coordinates

Color Bin Structure, Continued

MXCx-PW50-xxxx Color Bin Structure

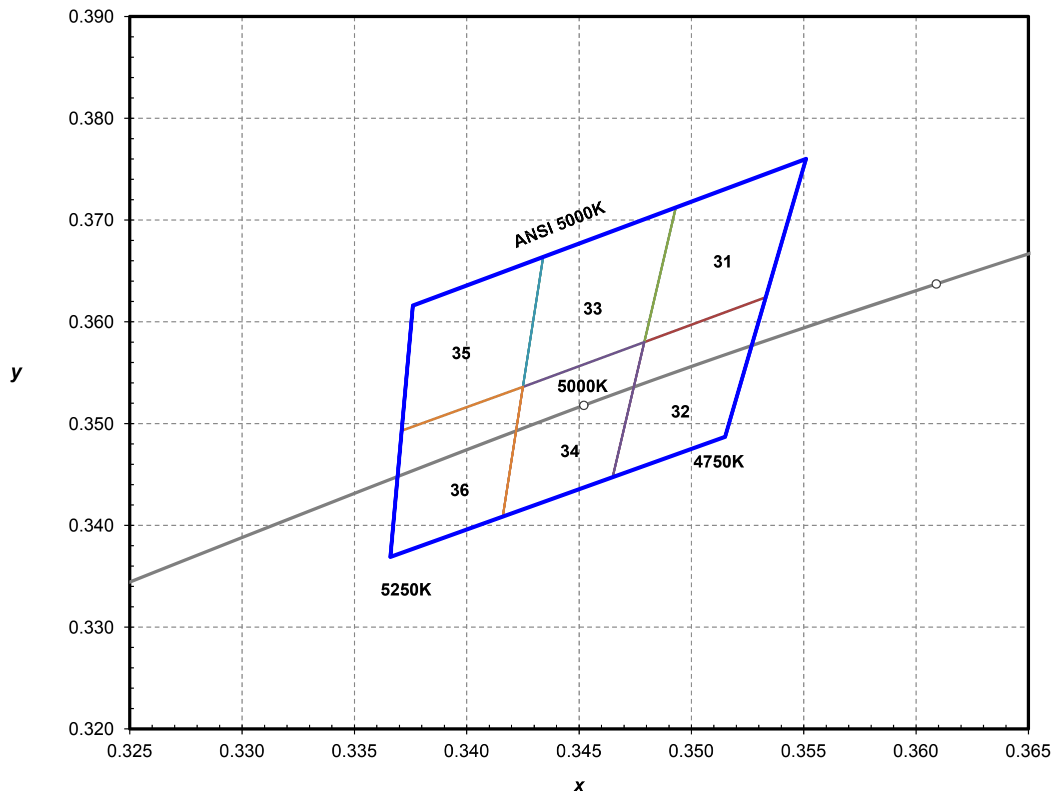


Figure 16. ANSI 5000K 1/6th color bin structure.

LUXEON Mid-Power Emitters are tested and binned by x,y coordinates.

Table 13.

LUXEON Mid-Power ANSI 1/6 Color Bin Coordinates for MXCx-PW50-xxxx Emitter					
Bin Code	x	y	Bin Code	x	y
31	0.3479 0.3493 0.3551 0.3533	0.3580 0.3712 0.3760 0.3624	34	0.3416 0.3425 0.3479 0.3465	0.3408 0.3536 0.3580 0.3448
32	0.3465 0.3479 0.3533 0.3515	0.3448 0.3580 0.3624 0.3487	35	0.3371 0.3376 0.3434 0.3425	0.3493 0.3616 0.3664 0.3536
33	0.3425 0.3434 0.3493 0.3479	0.3536 0.3664 0.3712 0.3580	36	0.3366 0.3371 0.3425 0.3416	0.3369 0.3493 0.3536 0.3408

Notes for Table 13:

1. Tested and binned at 25°C and If = 100 mA. Tester tolerance: +/- 0.01 in x and y coordinates

Color Bin Structure, Continued

MXCx-PW57-xxxxx Color Bin Structure

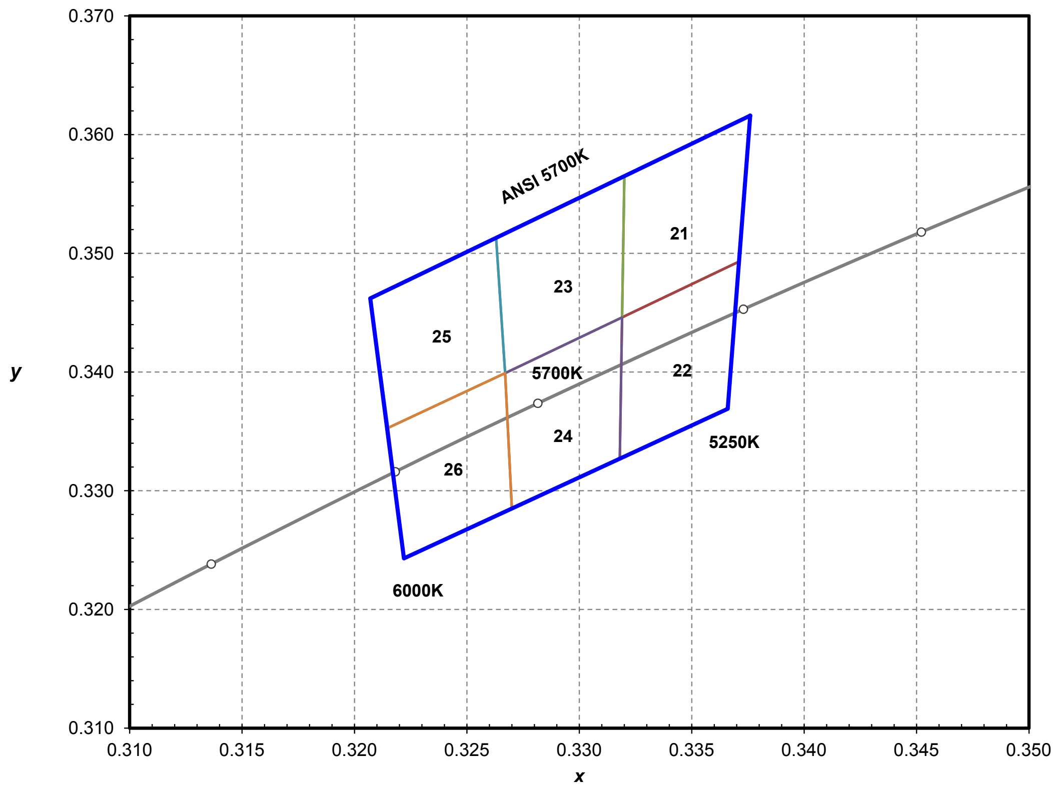


Figure 17. ANSI 5700K 1/6th color bin structure.

LUXEON Mid-Power Emitters are tested and binned by x,y coordinates.

Table 14.

LUXEON Mid-Power ANSI 1/6 Color Bin Coordinates for MXCx-PW57-xxxxx Emitter					
Bin Code	x	y	Bin Code	x	y
21	0.3319 0.3320 0.3376 0.3371	0.3446 0.3565 0.3616 0.3493	24	0.3270 0.3267 0.3319 0.3318	0.3285 0.3399 0.3446 0.3327
22	0.3318 0.3319 0.3371 0.3366	0.3327 0.3446 0.3493 0.3369	25	0.3215 0.3207 0.3263 0.3267	0.3353 0.3462 0.3513 0.3399
23	0.3267 0.3263 0.3320 0.3319	0.3399 0.3513 0.3565 0.3446	26	0.3222 0.3215 0.3267 0.3270	0.3243 0.3353 0.3399 0.3285

Notes for Table 14:

1. Tested and binned at 25°C and If = 100 mA. Tester tolerance: +/- 0.01 in x and y coordinates

Color Bin Structure, Continued

MXCx-PW65-xxxxx Color Bin Structure

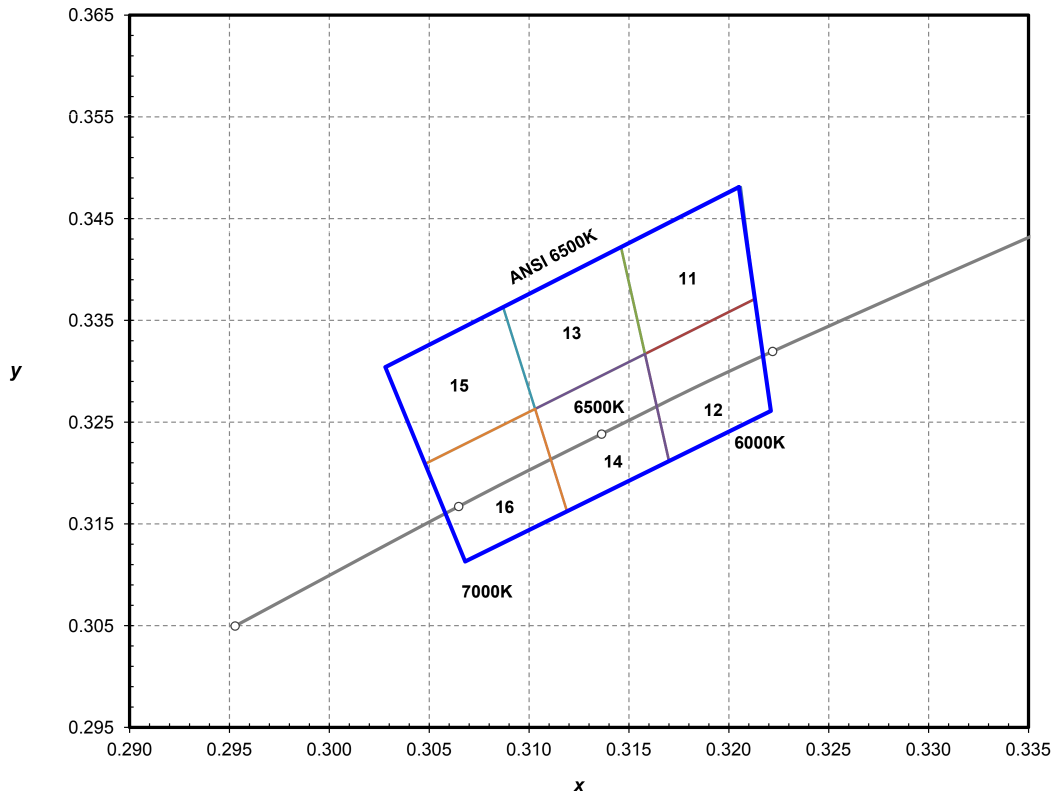


Figure 18. ANSI 6500K 1/6th color bin structure.

LUXEON Mid-Power Emitters are tested and binned by x,y coordinates.

Table 15.

LUXEON Mid-Power ANSI 1/6 Color Bin Coordinates for MXCx-PW65-xxxxx Emitter					
Bin Code	x	y	Bin Code	x	y
11	0.3158 0.3146 0.3206 0.3213	0.3317 0.3422 0.3481 0.3371	14	0.3119 0.3103 0.3158 0.3170	0.3162 0.3263 0.3317 0.3212
12	0.3170 0.3158 0.3213 0.3221	0.3212 0.3317 0.3371 0.3261	15	0.3048 0.3028 0.3087 0.3103	0.3209 0.3304 0.3363 0.3263
13	0.3103 0.3087 0.3146 0.3158	0.3263 0.3363 0.3422 0.3317	16	0.3068 0.3048 0.3103 0.3119	0.3113 0.3209 0.3263 0.3162

Notes for Table 15:

1. Tested and binned at 25°C and If = 100 mA. Tester tolerance: +/- 0.01 in x and y coordinates

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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