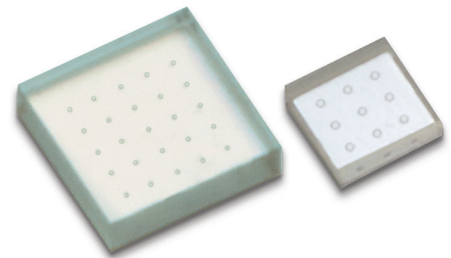




# LUXEON FlipChip Royal Blue

## High current density Chip Scale Package (CSP) LED

Customers now have complete design flexibility to access Lumileds industry leading performance at the die level and customize the phosphor and packaging to best suit their lighting applications with two package sizes, 0.5mm<sup>2</sup> and 1.0mm<sup>2</sup> LUXEON FlipChip Royal Blue. LUXEON FlipChip Royal Blue is a real Chip Scale Package (CSP) LED that can be attached by reflow without additional packaging. Traditional wire bonding limits the packing and power density of LEDs. LUXEON FlipChip Royal Blue LEDs can be packaged closer and can be driven at a higher current density, therefore requiring fewer emitters to achieve a higher lumen output at higher lumen densities.



### FEATURES AND BENEFITS

Micro sized CSP: 0.5mm<sup>2</sup> and 1.0mm<sup>2</sup> package for design flexibility and packing density

No wire bonds allows for SMT direct attach and reflow

5-sided emitter enables wide viewing angles

445–460nm wavelength range for dispense and remote phosphor applications

Low thermal resistance of 1.5°K/W (1mm<sup>2</sup>) for leading system level lm/\$

### PRIMARY APPLICATIONS

Display

Flash

Illumination

# Table of Contents

<b>General Product Information</b> .....	<b>2</b>
Product Test Conditions .....	2
Part Number Nomenclature .....	2
Lumen Maintenance .....	2
Environmental Compliance .....	2
<b>Performance Characteristics</b> .....	<b>3</b>
Product Selection Guide .....	3
Optical Characteristics .....	3
Electrical and Thermal Characteristics .....	4
Absolute Maximum Ratings .....	4
<b>Characteristic Curves</b> .....	<b>5</b>
Spectral Power Distribution Characteristics .....	5
Light Output Characteristics .....	5
Forward Current Characteristics .....	6
Color Shift Characteristics .....	7
Radiation Pattern Characteristics .....	9
<b>Product Bin and Labeling Definitions</b> .....	<b>10</b>
Decoding Product Bin Labeling .....	10
Radiometric Power Bins .....	10
Dominant Wavelength Bins .....	11
Forward Voltage Bins .....	11
<b>Mechanical Dimensions</b> .....	<b>12</b>
<b>Reflow Soldering Guidelines</b> .....	<b>13</b>
JEDEC Moisture Sensitivity .....	13
Solder Pad Design .....	14
<b>Packaging Information</b> .....	<b>15</b>
Bin Tape Dimensions .....	15
Product Labeling .....	15

# General Product Information

## Product Test Conditions

LUXEON FlipChip Royal Blue LEDs are tested and binned with a DC drive current of 175mA for 0.5mm<sup>2</sup> and 350mA for 1.0mm<sup>2</sup> at a junction temperature,  $T_j$ , of 25°C.

## Part Number Nomenclature

Part numbers for LUXEON FlipChip Royal Blue follow the convention below:

L 0 F 2 – B **A A A C C C C** 0 **D D D** 1

Where:

- A A A** – designates minimum dominant wavelength (445=445nm, 450=450nm, 455=455nm)
- C C C C** – designates die dimension (0500=0.5mm<sup>2</sup>, 1000=1.0mm<sup>2</sup>)
- D D D** – designates minimum radiometric power (275=275mW, 550=550mW)

Therefore, the following part number is used for a 1.0mm<sup>2</sup> LUXEON FlipChip Royal Blue with a minimum dominant wavelength of 450nm and minimum radiometric power performance of 550mW:

L 0 F 2 – B **4 5 0 1 0 0 0** 0 **5 5 0** 1

## Lumen Maintenance

Please contact your local Sales Representative or Lumileds Technical Solutions Manager for more information about the long-term performance of this product.

## Environmental Compliance

Lumileds LLC is committed to providing environmentally friendly products to the solid-state lighting market. LUXEON FlipChip Royal Blue is compliant to the European Union directives on the restriction of hazardous substances in electronic equipment, namely the RoHS Directive 2011/65/EU and REACH Regulation (EC) 1907/2006. Lumileds LLC will not intentionally add the following restricted materials to its products: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE).

# Performance Characteristics

## Product Selection Guide

Table 1. Product performance of LUXEON FlipChip Royal Blue at test current,  $T_j=25^\circ\text{C}$ .

SIZE (mm <sup>2</sup> )	DOMINANT WAVELENGTH <sup>[1]</sup> (nm)		RADIOMETRIC POWER <sup>[2, 3]</sup> (mW)		TEST CURRENT (mA)	PART NUMBER
	MINIMUM	MAXIMUM	MINIMUM	TYPICAL		
0.5	445	450	275	287	175	LOF2-B445050002751
	450	455	275	287	175	LOF2-B450050002751
	455	460	275	287	175	LOF2-B455050002751
1.0	445	450	550	575	350	LOF2-B445100005501
	450	455	550	575	350	LOF2-B450100005501
	455	460	550	575	350	LOF2-B455100005501

**Notes for Table 1:**

1. Lumileds maintains a tolerance of  $\pm 2\text{nm}$  on dominant wavelength measurements.
2. Lumileds maintains a tolerance of  $\pm 6.5\%$  on radiometric power measurements.
3. Radiometric power values are based on a die packaged on ceramic tile with high reflective surface and dome encapsulation.

## Optical Characteristics

Table 2. Optical characteristics for LUXEON FlipChip Royal Blue at test current,  $T_j=25^\circ\text{C}$ .

PART NUMBER	TYPICAL SPECTRA HALF-WIDTH (nm)	TYPICAL TEMPERATURE COEFFICIENT OF DOMINANT WAVELENGTH <sup>[1]</sup> (nm/ $^\circ\text{C}$ )	TYPICAL TOTAL INCLUDED ANGLE <sup>[2]</sup>	TYPICAL VIEWING ANGLE <sup>[3]</sup>
LOF2-B445050002751	24	0.05	149 $^\circ$	134 $^\circ$
LOF2-B450050002751	24	0.05	149 $^\circ$	134 $^\circ$
LOF2-B455050002751	24	0.05	149 $^\circ$	134 $^\circ$
LOF2-B445100005501	24	0.05	148 $^\circ$	139 $^\circ$
LOF2-B450100005501	24	0.05	148 $^\circ$	139 $^\circ$
LOF2-B455100005501	24	0.05	148 $^\circ$	139 $^\circ$

**Notes for Table 2:**

1. Measured between  $25^\circ\text{C}$  and  $85^\circ\text{C}$  at  $I_f=175\text{mA}$  (0.5mm<sup>2</sup>) and  $I_f=350\text{mA}$  (1mm<sup>2</sup>).
2. Total angle at which 90% of total luminous flux is captured.
3. Viewing angle is the off axis angle from the LED centerline where the luminous intensity is  $\frac{1}{2}$  of the peak value.

## Electrical and Thermal Characteristics

Table 3. Electrical and thermal characteristics for LUXEON FlipChip Royal Blue at test current,  $T_j=25^{\circ}\text{C}$ .

PART NUMBER	FORWARD VOLTAGE <sup>[1]</sup> ( $V_f$ )			TYPICAL TEMPERATURE COEFFICIENT OF FORWARD VOLTAGE <sup>[2]</sup> (mV/ $^{\circ}\text{C}$ )	TYPICAL THERMAL RESISTANCE—JUNCTION TO SOLDER PAD ( $^{\circ}\text{C}/\text{W}$ )
	MINIMUM	TYPICAL	MAXIMUM		
L0F2-B4xx050002751	2.7	2.9	3.1	-2 to -3	2.5
L0F2-B4xx100005501	2.7	2.9	3.1	-2 to -3	1.5

**Notes for Table 3:**

1. Lumileds maintains a tolerance of  $\pm 0.06\text{V}$  on forward voltage measurements.
2. Measured between  $25^{\circ}\text{C}$  and  $85^{\circ}\text{C}$ .

## Absolute Maximum Ratings

Table 4. Absolute maximum ratings for LUXEON FlipChip Royal Blue.

PARAMETER	MAXIMUM PERFORMANCE
DC Forward Current <sup>[1,2]</sup>	500mA (0.5mm <sup>2</sup> ) 1050mA (1.0mm <sup>2</sup> )
Peak Pulsed Forward Current <sup>[1,3]</sup>	650mA (0.5mm <sup>2</sup> ) 1300mA (1.0mm <sup>2</sup> )
LED Junction Temperature <sup>[1]</sup> (DC & Pulse)	135 $^{\circ}\text{C}$
ESD Sensitivity (ANSI/ESDA/JEDEC JS-001-2012)	CLASS 0B
Operating Case Temperature <sup>[1]</sup>	-40 $^{\circ}\text{C}$ to 105 $^{\circ}\text{C}$
LED Storage Temperature	-40 $^{\circ}\text{C}$ to 135 $^{\circ}\text{C}$
Soldering Temperature	260 $^{\circ}\text{C}$ if use SAC solder
Allowable Reflow Cycles	3
Reverse Voltage ( $V_{\text{reverse}}$ )	LUXEON LEDs are not designed to be driven in reverse bias

**Notes for Table 4:**

1. Proper current derating must be observed to maintain the junction temperature below the maximum allowable junction temperature.
2. Residual periodic variations due to power conversion from alternating current (AC) to direct current (DC), also called "ripple," are acceptable if the following conditions are met:
  - The frequency of the ripple current is 100Hz or higher
  - The average current for each cycle does not exceed the maximum allowable DC forward current
  - The maximum amplitude of the ripple does not exceed the maximum peak pulsed forward current
3. Pulsed operation with a peak drive current of 650mA (0.5mm<sup>2</sup>) and 1300mA (1.0mm<sup>2</sup>) is acceptable if the pulse on-time is  $\leq 5\text{ms}$  per cycle and the duty cycle is  $\leq 50\%$ .

# Characteristic Curves

## Spectral Power Distribution Characteristics

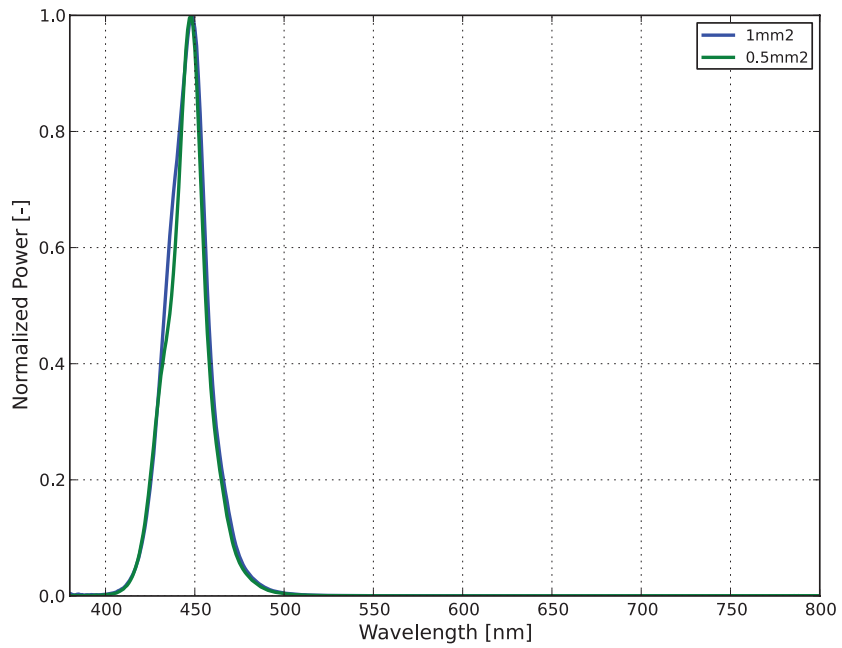


Figure 1. Typical normalized power vs. wavelength for L0F2-Bxxxxxxx0xxx1 at specified test current,  $T_j=25^{\circ}\text{C}$ .

## Light Output Characteristics

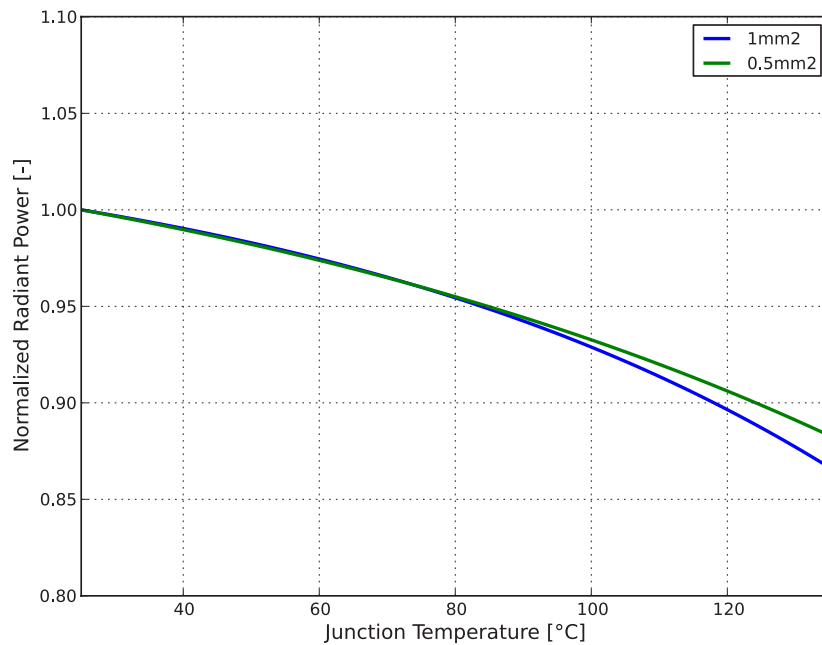


Figure 2. Typical normalized radiant power vs. junction temperature for L0F2-Bxxx050002751 at 175mA and L0F2-Bxxx100005501 at 350mA.

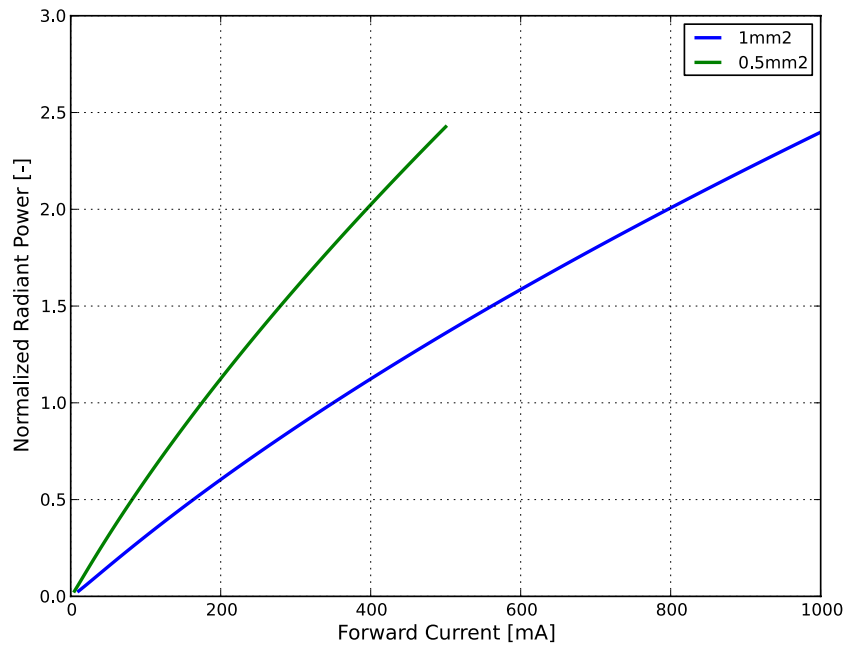


Figure 3. Typical relative radiometric power vs. forward current for L0F2-Bxxx050002751 and L0F2-Bxxx100005501 at  $T_j=25^\circ\text{C}$ .

## Forward Current Characteristics

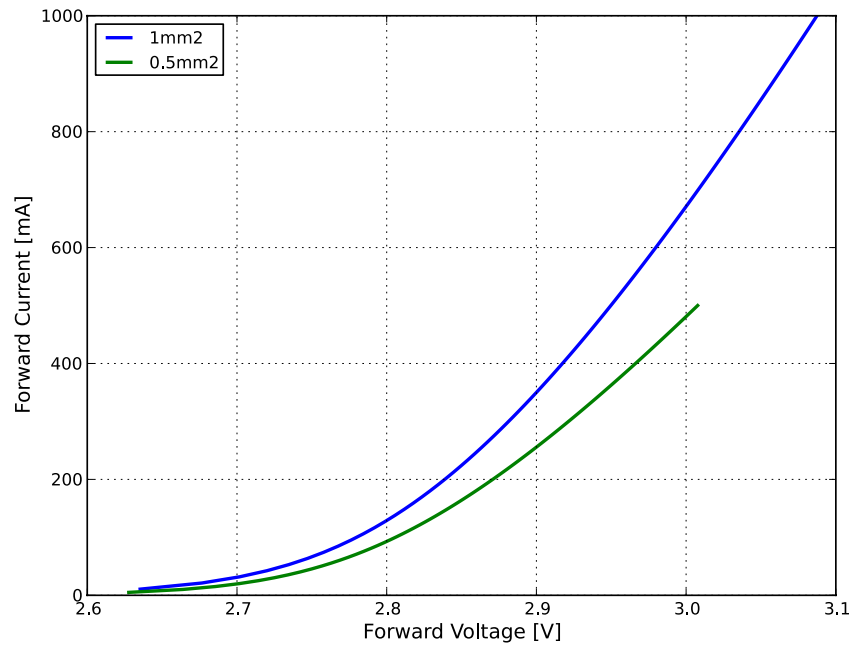


Figure 4. Typical forward current vs. forward voltage for L0F2-Bxxxxxxx0xxx1 at  $T_j=25^\circ\text{C}$ .

# Color Shift Characteristics

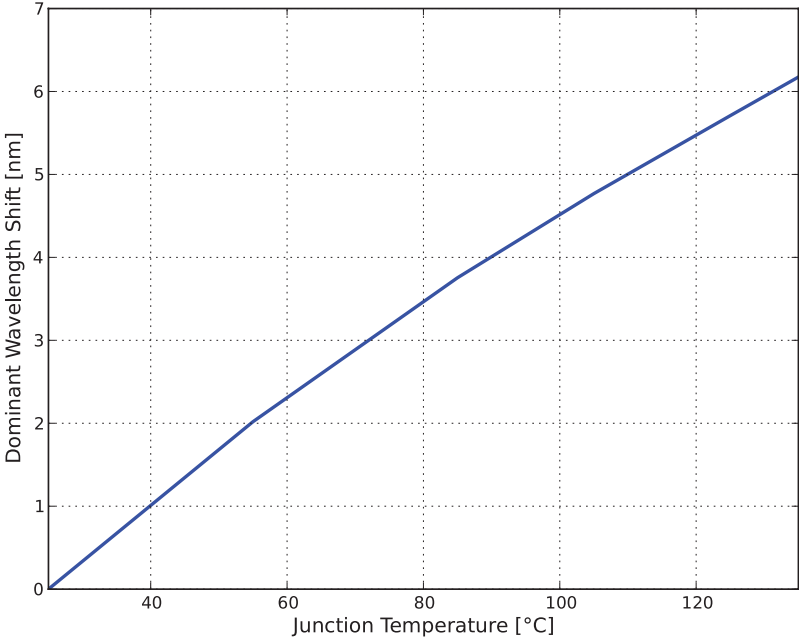


Figure 5a. Dominant wavelength shift vs. junction temperature for L0F2-Bxxx050002751 at  $T_j=25^\circ\text{C}$ .

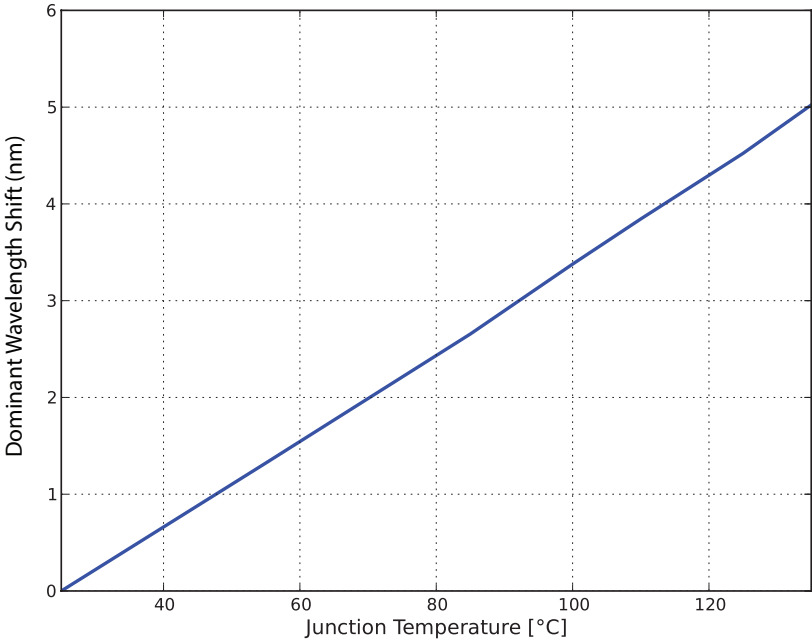


Figure 5b. Dominant wavelength shift vs. junction temperature for L0F2-Bxxx100005501 at  $T_j=25^\circ\text{C}$ .



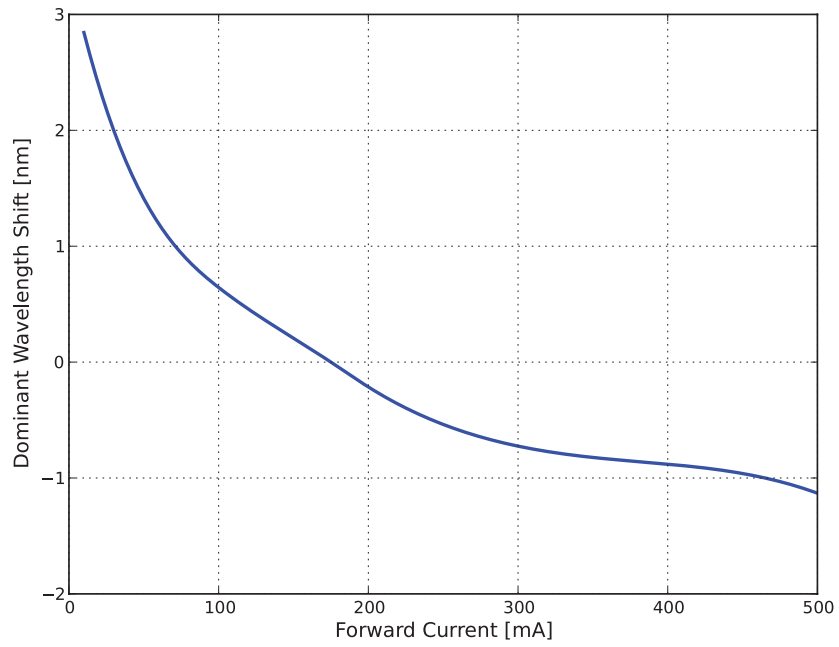


Figure 6a. Dominant wavelength shift vs. forward current for L0F2-Bxxx050002751 at T<sub>j</sub>=25°C.

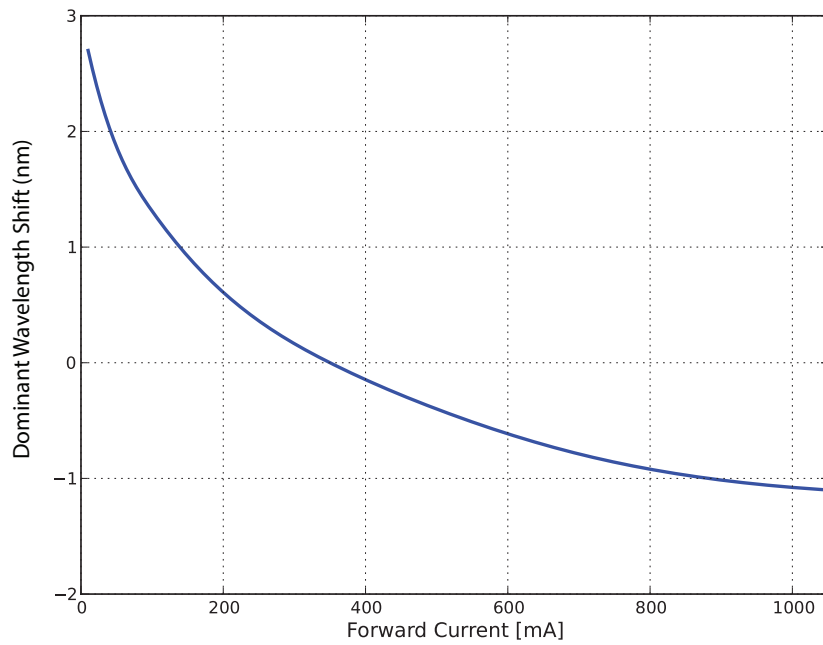


Figure 6b. Dominant wavelength shift vs. junction temperature for L0F2-Bxxx100005501 at T<sub>j</sub>=25°C.

# Radiation Pattern Characteristics

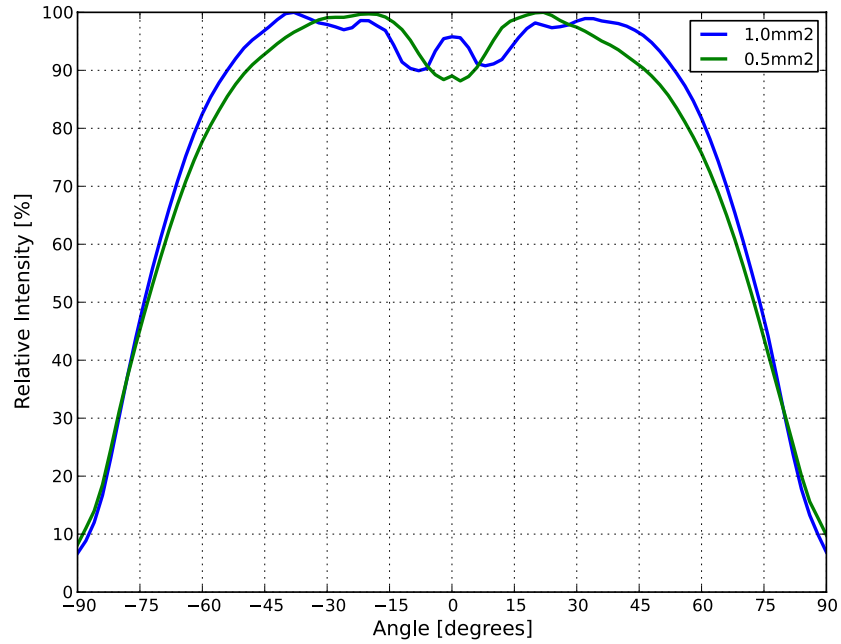


Figure 7. Typical radiation pattern for LUXEON FlipChip Royal Blue at specified test current mA,  $T_j=25^{\circ}\text{C}$ .

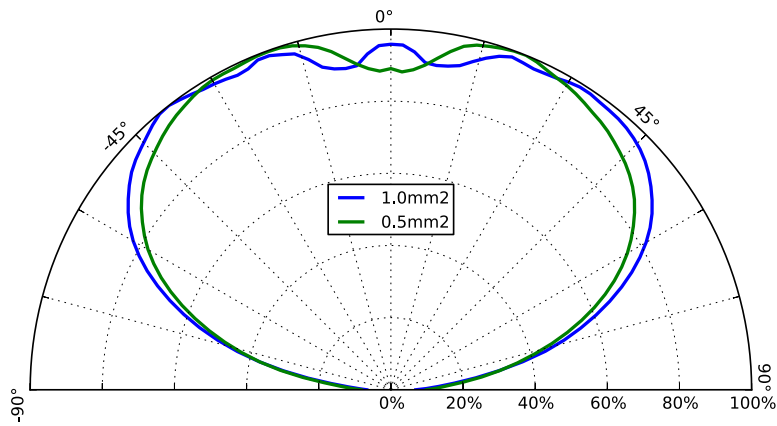


Figure 8. Typical polar radiation pattern for LUXEON FlipChip Royal Blue at specified test current mA,  $T_j=25^{\circ}\text{C}$ .

# Product Bin and Labeling Definitions

## Decoding Product Bin Labeling

In the manufacturing of semiconductor products, there are variations in performance around the average values given in the technical datasheet. For this reason, Lumileds bins LED components for luminous flux or radiometric power, color point, peak or dominant wavelength and forward voltage.

LUXEON FlipChip Royal Blue LEDs are labeled using a 4-digit alphanumeric CAT code following the format below:

### A B C D

- A** – designates radiometric power bin (example: Z=300 to 325mW, B=350 to 375mW)
- B C** – designates dominant wavelength bin (example: 4x=445 to 450nm, 5x=450 to 455nm)
- D** – designates forward voltage bin (example: 8=2.8 to 2.9V, 9=2.9 to 3.0V)

Therefore, a LUXEON FlipChip Royal Blue with a radiometric power range of 300 to 325mW, dominant wavelength range of 445 to 450nm and a forward voltage range of 2.8 to 2.9V has the following CAT code:

### Z 4 x 8

## Radiometric Power Bins

Table 5. Radiometric power bin definitions for LUXEON FlipChip Royal Blue.

BIN	RADIOMETRIC POWER <sup>(1)</sup> (mW)	
	MINIMUM	MAXIMUM
Y	275	300
Z	300	325
A	325	350
B	350	375
G	550	600
H	600	650
I	650	700

**Notes for Table 5:**

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  on radiometric power measurements.

## Dominant Wavelength Bins

Table 7. Dominant wavelength bins for LUXEON FlipChip Royal Blue.

BIN	DOMINANT WAVELENGTH <sup>(1)</sup> (nm)	
	MINIMUM	MAXIMUM
4x	445	450
5x	450	455
6x	455	460

**Notes for Table 7:**

1. Lumileds maintains a tolerance of  $\pm 2$ nm on dominant wavelength measurements.

## Forward Voltage Bins

Table 8. Forward voltage bin definitions for LUXEON FlipChip Royal Blue.

BIN	FORWARD VOLTAGE <sup>(1)</sup> (V <sub>f</sub> )	
	MINIMUM	MAXIMUM
8	2.8	2.9
9	2.9	3.0
0	3	3.1

**Notes for Table 8:**

1. Lumileds maintains a tolerance of  $\pm 0.06$ V on forward voltage measurements.

# Mechanical Dimensions

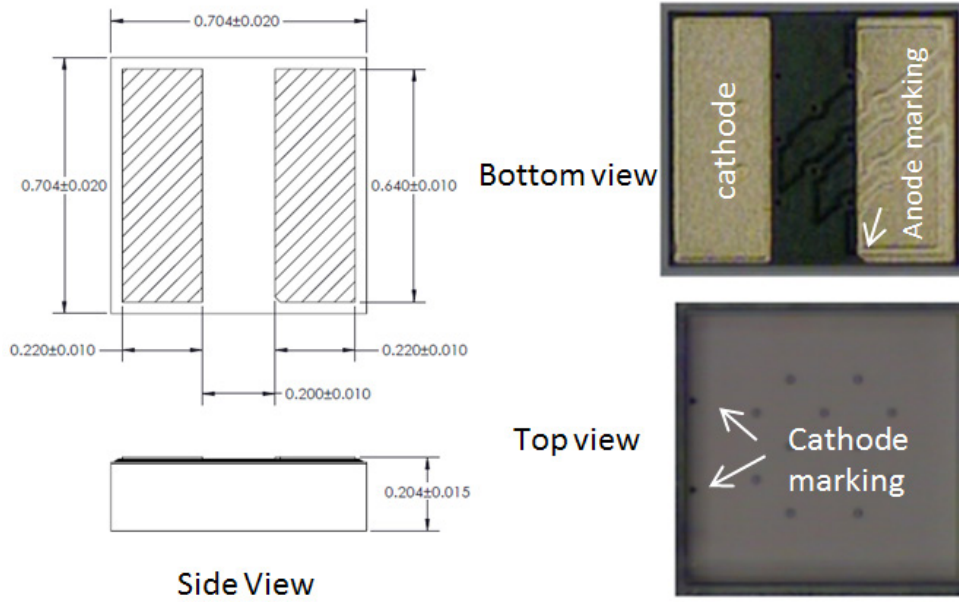


Figure 9a. Mechanical dimensions for LUXEON FlipChip Royal Blue L0F2-Bxxx050002751.

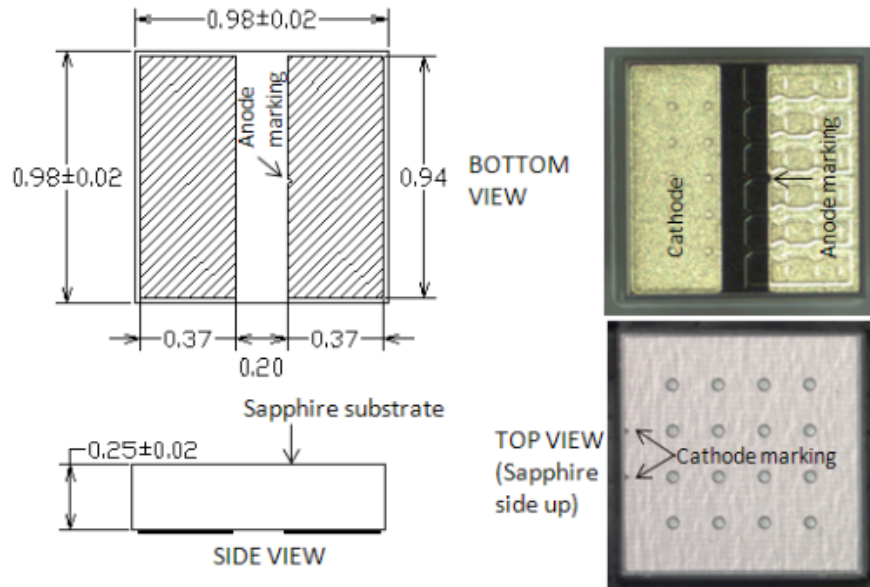


Figure 9b. Mechanical dimensions for LUXEON FlipChip Royal Blue L0F2-Bxxx100005501.

- Notes for Figures 9a and 9b:
1. Drawings are not to scale.
  2. All dimensions are in millimeters.

# Reflow Soldering Guidelines

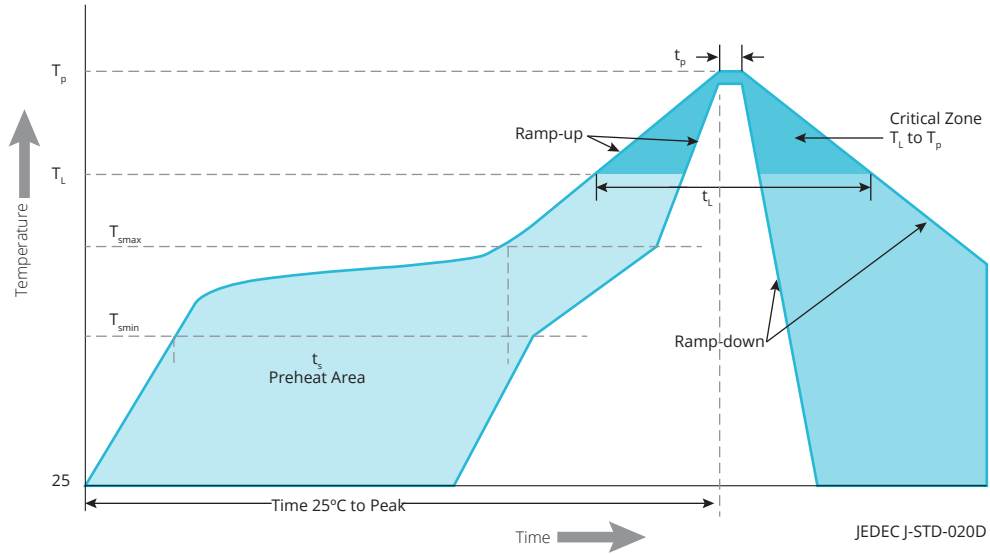


Figure 10. Visualization of the acceptable reflow temperature profile as specified in Table 9.

Table 9. Reflow profile characteristics for LUXEON FlipChip Royal Blue.

PROFILE FEATURE	LEAD-FREE ASSEMBLY
Preheat Minimum Temperature ( $T_{smin}$ )	150°C
Preheat Maximum Temperature ( $T_{smax}$ )	200°C
Preheat Time ( $t_{smin}$ to $t_{smax}$ )	60 to 120 seconds
Ramp-Up Rate ( $T_L$ to $T_p$ )	3°C / second maximum
Liquidus Temperature ( $T_L$ )	217°C
Time Maintained Above Temperature $T_L$ ( $t_L$ )	60 to 150 seconds
Peak / Classification Temperature ( $T_p$ )	260°C
Time Within 5°C of Actual Temperature ( $t_p$ )	20 to 40 seconds
Ramp-Down Rate ( $T_p$ to $T_L$ )	6°C / second maximum
Time 25°C to Peak Temperature	8 minutes maximum

## JEDEC Moisture Sensitivity

Table 10. Moisture sensitivity levels for LUXEON FlipChip Royal Blue.

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

# Solder Pad Design

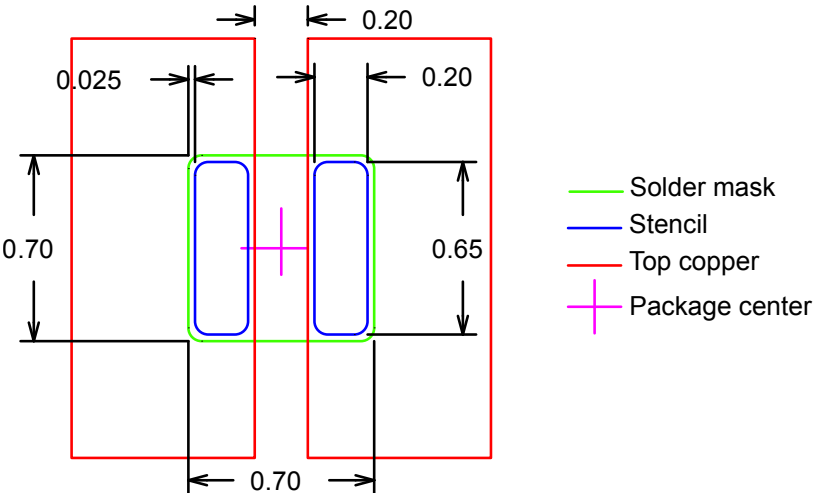


Figure 11a. Recommended PCB solder pad layout for L0F2-Bxxx5000xxx1.

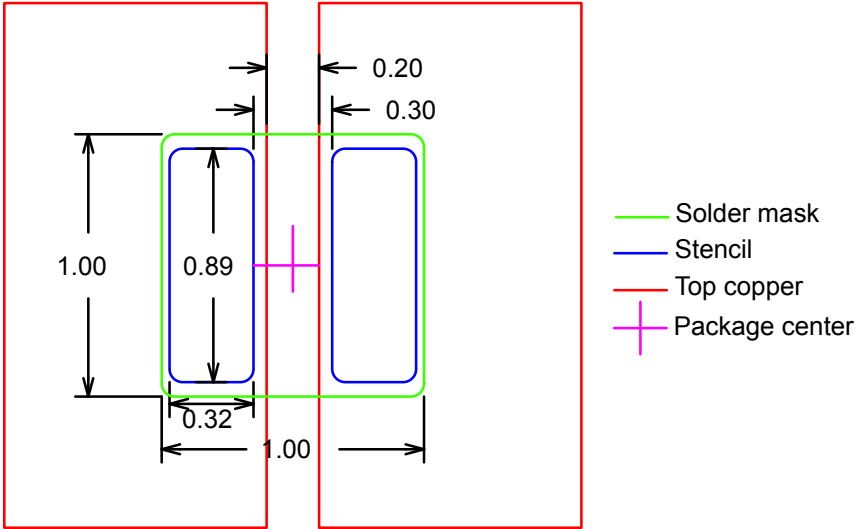


Figure 11b. Recommended PCB solder pad layout for L0F2-Bxxx1000xxx1.

Notes for Figures 11a and 11b:  
 1. Drawings are not to scale.  
 2. All dimensions are in millimeters.

# Packaging Information

LUXEON FlipChip Royal Blue dies are placed in the center of the blue adhesive tape with a maximum of 40 pieces in the x and y direction with a maximum length of 71 mm in both directions. A bin tape label is fixed in the lower left corner.

LUXEON FlipChip Royal Blue bin sheets are packaged in ESD green containers with no more than five sheets to a container.<sup>[1]</sup> Up to 4 ESD green containers are then packaged in a vacuumed ESD protective bag with a silicon gel packet and a summary of the bin sheets.

## Bin Tape Dimensions

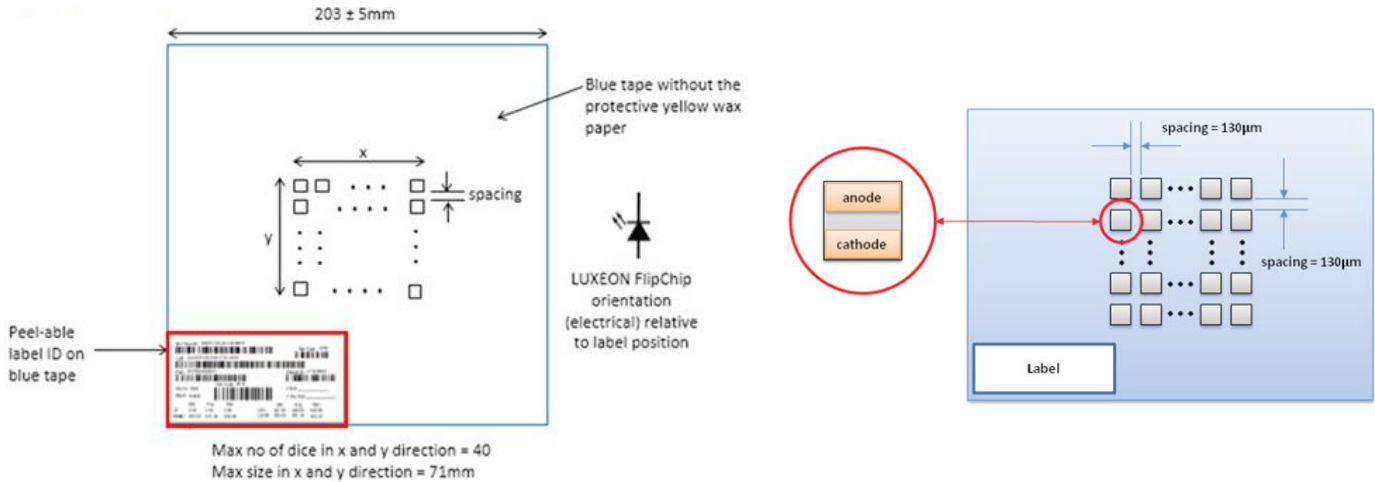


Figure 12. Bin Tape dimensions for LUXEON FlipChip Royal Blue.

## Product Labeling



Fig 13. Example of a bin sheet label for LUXEON FlipChip Royal Blue.

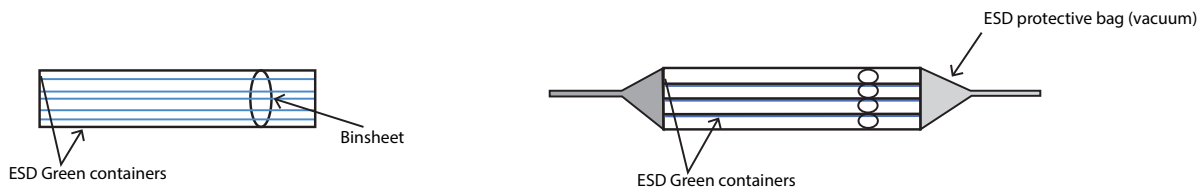


Fig 14. Example of a the packaging for LUXEON FlipChip Royal Blue.

- Notes for Figures 12, 13 and 14:
1. Drawings are not to scale.
  2. All dimensions are in millimeters.
  3. Bin sheets of different cat codes are permitted.



## About Lumileds

Lumileds is the global leader in light engine technology. The company develops, manufactures and distributes groundbreaking LEDs and automotive lighting products that shatter the status quo and help customers gain and maintain a competitive edge.

With a rich history of industry “firsts,” Lumileds is uniquely positioned to deliver lighting advancements well into the future by maintaining an unwavering focus on quality, innovation and reliability.

To learn more about our portfolio of light engines, visit [lumileds.com](http://lumileds.com).



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