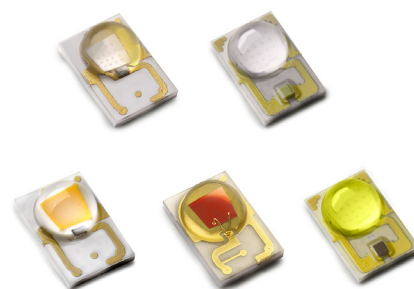


# LUXEON Rebel Color Line

High flux and efficacy on industry's most widely used color LED platform

The LUXEON Rebel Color Line has leading light output, color stability, flux density and clear saturated colors. These color LEDs are ideal for a wide variety of lighting, signaling, signage and entertainment applications. Every LUXEON Rebel Color emitter has built-in quality, reliability, lumen maintenance and the ease of manufacturing needed to create a superior, high quality light. LUXEON Rebel Color emitters give designers an endless palette of colors to work with, adding interest, dimension and liveliness to all lighting projects.



## FEATURES AND BENEFITS

- Full color palette for a wider spectrum range
- Highest efficacy available for colors, allowing for lower power consumption
- High flux and leading hot and cold performance for saturated colors
- Fully developed ecosystem for LUXEON Rebel platforms

## PRIMARY APPLICATIONS

- Architectural
- Lamps
- Specialty Lighting
  - Emergency Lighting
  - Entertainment

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# General Product Information

## Product Test Conditions

LUXEON Rebel Color Line LEDs are tested and binned with a DC drive current and junction temperature specified below:

|                                                     |                                   |
|-----------------------------------------------------|-----------------------------------|
| LUXEON Rebel Lime                                   | – 350mA, $T_j=85^{\circ}\text{C}$ |
| LUXEON Rebel ES Blue and LUXEON Rebel ES Royal Blue | – 700mA, $T_j=25^{\circ}\text{C}$ |
| All other colors                                    | – 350mA, $T_j=25^{\circ}\text{C}$ |

## Part Number Nomenclature

Part numbers for LUXEON Rebel Color Line follow the convention below:

L X M L – P **A** 0 **B** – **C C C C**  
L X M 2 – P **A** 0 **B** – **C C C C**  
L X M 3 – P **A** 0 **B** – **C C C C**  
L X M 5 – P **A** 0 **B**

Where:

- A** – designates color (X=Lime, M=Green, E=Cyan, B=Blue, R=Royal Blue, F=Far Red, D=Deep Red and Red, H=Red-Orange, L=PC Amber and Amber, B=Blue, R=Royal Blue )
- B** – designates diode size (1=1 mm<sup>2</sup> and 2=2mm<sup>2</sup>)
- C C C C** – designates minimum luminous flux (lm) or radiometric power (mW) performance (see Product Selection Guide)

Therefore, the following part number is used for a LUXEON Rebel Red, 1mm<sup>2</sup> diode size, with a minimum luminous flux of 50:

L X M 2 – P **D** 0 **1** – **0 0 5 0**

## 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 Rebel Color Line 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 Rebel Color Line at test conditions.

| COLOR      | DOMINANT <sup>[1, 2]</sup> or<br>PEAK WAVELENGTH <sup>[2]</sup> (nm) |         | LUMINOUS FLUX <sup>[1, 3]</sup> (lm) or<br>RADIOMETRIC POWER <sup>[3]</sup> (mW) |         | TEST CURRENT<br>(mA) | PART NUMBER                   |
|------------|----------------------------------------------------------------------|---------|----------------------------------------------------------------------------------|---------|----------------------|-------------------------------|
|            | MINIMUM                                                              | MAXIMUM | MINIMUM                                                                          | TYPICAL |                      |                               |
| Far Red    | 720                                                                  | 750     | 210                                                                              | 260     | 350                  | LXML-PF01                     |
| Deep Red   | 650                                                                  | 670     | 270                                                                              | 360     | 350                  | LXM3-PD01                     |
| Red        | 620                                                                  | 645     | 60                                                                               | 62      | 350                  | LXM2-PD01-0060                |
|            | 620                                                                  | 645     | 50                                                                               | 53      | 350                  | LXM2-PD01-0050                |
|            | 620                                                                  | 645     | 40                                                                               | 48      | 350                  | LXM2-PD01-0040                |
|            | 620                                                                  | 645     | 50                                                                               | 52      | 350                  | LXML-PD01-0050                |
|            | 620                                                                  | 645     | 40                                                                               | 46      | 350                  | LXML-PD01-0040                |
|            | 620                                                                  | 645     | 30                                                                               | 38      | 350                  | LXML-PD01-0030                |
|            | 620                                                                  | 645     | 50                                                                               | 64      | 350                  | LXM5-PD01                     |
| Red-Orange | 610                                                                  | 620     | 70                                                                               | 72      | 350                  | LXM2-PH01-0070                |
|            | 610                                                                  | 620     | 60                                                                               | 67      | 350                  | LXM2-PH01-0060                |
|            | 610                                                                  | 620     | 60                                                                               | 62      | 350                  | LXML-PH01-0060                |
|            | 610                                                                  | 620     | 50                                                                               | 56      | 350                  | LXML-PH01-0050                |
|            | 610                                                                  | 620     | 50                                                                               | 90      | 350                  | LXM5-PH01                     |
| PC Amber   | 594                                                                  | 604     | 80                                                                               | 110     | 350                  | LXM2-PL01-0000                |
| Amber      | 585                                                                  | 595     | 60                                                                               | 61      | 350                  | LXML-PL01-0060                |
|            | 585                                                                  | 595     | 50                                                                               | 54      | 350                  | LXML-PL01-0050                |
|            | 585                                                                  | 595     | 40                                                                               | 48      | 350                  | LXML-PL01-0040                |
|            | 585                                                                  | 595     | 30                                                                               | 38      | 350                  | LXML-PL01-0030                |
|            | 585                                                                  | 595     | 50                                                                               | 74      | 350                  | LXM5-PL01                     |
| Lime       | 566                                                                  | 569     | 140                                                                              | 184     | 350                  | LXML-PX02-0000                |
| Green      | 520                                                                  | 540     | 100                                                                              | 102     | 350                  | LXML-PM01-0100                |
|            | 520                                                                  | 540     | 90                                                                               | 95      | 350                  | LXML-PM01-0090                |
|            | 520                                                                  | 540     | 80                                                                               | 88      | 350                  | LXML-PM01-0080                |
|            | 520                                                                  | 540     | 70                                                                               | 79      | 350                  | LXML-PM01-0070                |
| Cyan       | 490                                                                  | 515     | 80                                                                               | 83      | 350                  | LXML-PE01-0080                |
|            | 490                                                                  | 515     | 70                                                                               | 76      | 350                  | LXML-PE01-0070                |
|            | 490                                                                  | 515     | 60                                                                               | 67      | 350                  | LXML-PE01-0060                |
| Blue       | 460                                                                  | 485     | 40                                                                               | 41      | 350                  | LXML-PB01-0040                |
|            | 460                                                                  | 485     | 30                                                                               | 35      | 350                  | LXML-PB01-0030                |
|            | 460                                                                  | 485     | 23                                                                               | 28      | 350                  | LXML-PB01-0023                |
|            | 460                                                                  | 485     | 18                                                                               | 22      | 350                  | LXML-PB01-0018                |
|            | 460                                                                  | 485     | 50                                                                               | 74      | 700                  | LXML-PB02                     |
| Royal Blue | 440                                                                  | 460     | 500                                                                              | 520     | 350                  | LXML-PR01-0500                |
|            | 440                                                                  | 460     | 1100                                                                             | 1120    | 700                  | LXML-PR02-1100                |
|            | 440                                                                  | 460     | 1050                                                                             | 1070    | 700                  | LXML-PR02-1050                |
|            | 440                                                                  | 460     | 1000                                                                             | 1030    | 700                  | LXML-PR02-1000                |
|            | 440                                                                  | 460     | 950                                                                              | 970     | 700                  | LXML-PR02-0950                |
|            | 440                                                                  | 460     | 900                                                                              | 940     | 700                  | LXML-PR02-0900                |
|            | 440                                                                  | 460     | 800                                                                              | 890     | 700                  | LXML-PR02-0800                |
|            | 440                                                                  | 460     | 900                                                                              | 1030    | 700                  | LXML-PR02-A900 <sup>[4]</sup> |

**Notes for Table 1:**

- Lumileds maintains a tolerance of  $\pm 0.5\text{nm}$  for dominant wavelength and  $\pm 6.5\%$  on luminous flux measurements.
- Far Red, Deep Red and Royal Blue are binned by peak wavelength and all other colors by dominant wavelength.
- Far Red, Deep Red and Royal Blue are binned by radiometric power and all other colors by luminous flux.
- LXML-PR02-A900 is a selection of color bins 4 and 5 only.

Table 2. Optical characteristics for LUXEON Rebel Color Line at test conditions.

| COLOR      | PART NUMBER                 | TYPICAL SPECTRAL HALF-WIDTH <sup>[1]</sup> (nm) | TYPICAL TEMPERATURE COEFFICIENT OF DOMINANT or PEAK WAVELENGTH (nm/°C) | TYPICAL TOTAL INCLUDED ANGLE <sup>[2]</sup> | TYPICAL VIEWING ANGLE <sup>[3]</sup> |
|------------|-----------------------------|-------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------|--------------------------------------|
| Far Red    | LXML-PF01 <sup>[4]</sup>    | 30                                              | 0.17                                                                   | 145°                                        | 125°                                 |
| Deep Red   | LXM3-PD01 <sup>[4]</sup>    | 20                                              | 0.05                                                                   | 145°                                        | 125°                                 |
| Red        | LXM2-PD01 <sup>[4, 6]</sup> | 20                                              | 0.05                                                                   | 145°                                        | 125°                                 |
|            | LXML-PD01 <sup>[4, 6]</sup> | 20                                              | 0.05                                                                   | 145°                                        | 125°                                 |
|            | LXM5-PD01 <sup>[4, 6]</sup> | 20                                              | 0.05                                                                   | 145°                                        | 125°                                 |
| Red-Orange | LXM2-PH01 <sup>[4, 6]</sup> | 20                                              | 0.08                                                                   | 145°                                        | 125°                                 |
|            | LXML-PH01 <sup>[4, 6]</sup> | 20                                              | 0.08                                                                   | 145°                                        | 125°                                 |
|            | LXM5-PH01 <sup>[4, 6]</sup> | 20                                              | 0.08                                                                   | 145°                                        | 125°                                 |
| PC Amber   | LXM2-PL01 <sup>[5]</sup>    | 80                                              | -0.01                                                                  | 140°                                        | 120°                                 |
| Amber      | LXML-PL01 <sup>[4, 6]</sup> | 20                                              | 0.10                                                                   | 145°                                        | 125°                                 |
|            | LXM5-PL01 <sup>[4, 6]</sup> | 20                                              | 0.10                                                                   | 145°                                        | 125°                                 |
| Lime       | LXML-PX02 <sup>[5]</sup>    | 100                                             | 0.01                                                                   | 145°                                        | 125°                                 |
| Green      | LXML-PM01 <sup>[5]</sup>    | 30                                              | 0.05                                                                   | 145°                                        | 125°                                 |
| Cyan       | LXML-PE01 <sup>[5]</sup>    | 30                                              | 0.04                                                                   | 145°                                        | 125°                                 |
| Blue       | LXML-PB01 <sup>[5]</sup>    | 20                                              | 0.05                                                                   | 145°                                        | 125°                                 |
|            | LXML-PB02 <sup>[5]</sup>    | 20                                              | 0.05                                                                   | 145°                                        | 125°                                 |
| Royal Blue | LXML-PR01 <sup>[5]</sup>    | 20                                              | 0.04                                                                   | 145°                                        | 125°                                 |
|            | LXML-PR02 <sup>[5]</sup>    | 20                                              | 0.04                                                                   | 145°                                        | 125°                                 |

## Notes for Table 2:

1. Spectral width at ½ of the peak intensity.
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 ½ of the peak value.
4. Far Red, Deep Red, Red, Red-Orange and Amber products are built with aluminum indium gallium phosphide (AlInGaP).
5. PC Amber, Lime, Green, Cyan, Blue and Royal Blue products are built with Indium Gallium Nitride (InGaN).
6. Wavelength ranges for hot tested Red, Red-Orange and Amber have been defined to align with typical changes in spectral output at increased temperature.

## Electrical and Thermal Characteristics

Table 3. Electrical and thermal characteristics for LUXEON Rebel Color Line at test conditions.

| COLOR      | PART NUMBER | FORWARD VOLTAGE <sup>[1]</sup> (V <sub>f</sub> ) |         |         | TYPICAL TEMPERATURE COEFFICIENT OF FORWARD VOLTAGE <sup>[2]</sup> (mV/°C) | TYPICAL THERMAL RESISTANCE—JUNCTION TO SOLDER PAD (°C/W) |
|------------|-------------|--------------------------------------------------|---------|---------|---------------------------------------------------------------------------|----------------------------------------------------------|
|            |             | MINIMUM                                          | TYPICAL | MAXIMUM |                                                                           |                                                          |
| Far Red    | LXML-PF01   | 1.60                                             | 1.80    | 2.40    | -2.0 to -4.0                                                              | 5.50                                                     |
| Deep Red   | LXM3-PD01   | 1.80                                             | 2.10    | 2.80    | -2.0 to -4.0                                                              | 8.00                                                     |
| Red        | LXM2-PD01   | 1.80                                             | 2.10    | 2.80    | -2.0 to -4.0                                                              | 8.00                                                     |
|            | LXML-PD01   | 2.31                                             | 2.90    | 3.51    | -2.0 to -4.0                                                              | 12.00                                                    |
|            | LXM5-PD01   | 1.80                                             | 2.10    | 2.60    | -2.0 to -4.0                                                              | 7.00                                                     |
| Red-Orange | LXM2-PH01   | 1.80                                             | 2.10    | 2.80    | -2.0 to -4.0                                                              | 8.00                                                     |
|            | LXML-PH01   | 2.31                                             | 2.90    | 3.51    | -2.0 to -4.0                                                              | 12.00                                                    |
|            | LXM5-PH01   | 1.80                                             | 2.10    | 2.60    | -2.0 to -4.0                                                              | 7.00                                                     |
| PC Amber   | LXM2-PL01   | 2.55                                             | 3.05    | 3.51    | -2.0 to -4.0                                                              | 10.00                                                    |
| Amber      | LXML-PL01   | 2.31                                             | 2.90    | 3.51    | -2.0 to -4.0                                                              | 12.00                                                    |
|            | LXM5-PL01   | 1.80                                             | 2.10    | 2.60    | -2.0 to -4.0                                                              | 7.00                                                     |
| Lime       | LXML-PX02   | 2.60                                             | 2.75    | 3.00    | -2.0 to -4.0                                                              | 6.00                                                     |
| Green      | LXML-PM01   | 2.55                                             | 3.21    | 3.51    | -2.0 to -4.0                                                              | 10.00                                                    |
| Cyan       | LXML-PE01   | 2.55                                             | 3.17    | 3.51    | -2.0 to -4.0                                                              | 10.00                                                    |
| Blue       | LXML-PB01   | 2.55                                             | 2.95    | 3.51    | -2.0 to -4.0                                                              | 10.00                                                    |
|            | LXML-PB02   | 2.50                                             | 2.95    | 3.50    | -2.0 to -4.0                                                              | 6.00                                                     |
| Royal Blue | LXML-PR01   | 2.55                                             | 2.95    | 3.51    | -2.0 to -4.0                                                              | 10.00                                                    |
|            | LXML-PR02   | 2.50                                             | 2.90    | 3.50    | -2.0 to -4.0                                                              | 6.00                                                     |

## Notes for Table 3:

1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
2. Measured between 25°C and 110°C.

# Absolute Maximum Ratings

Table 4a. Absolute maximum ratings for LUXEON Rebel Color Line at  $T_J=25^{\circ}\text{C}$ .

| PARAMETER                                            | GREEN/CYAN/<br>BLUE/ROYAL BLUE                                 | ES BLUE/<br>ES ROYAL BLUE | FAR RED/<br>DEEP RED/RED/<br>RED-ORANGE/AMBER | PC AMBER         |
|------------------------------------------------------|----------------------------------------------------------------|---------------------------|-----------------------------------------------|------------------|
| DC Forward Current <sup>[1,2]</sup>                  | 1000mA                                                         | 1000                      | 700mA                                         | 700mA            |
| Peak Pulsed Forward Current <sup>[1,3]</sup>         | 1000mA                                                         | 1200                      | 700mA                                         | 700mA            |
| LED Junction Temperature <sup>[1]</sup> (DC & Pulse) | 150°C                                                          | 150°C                     | 135°C                                         | 130°C            |
| ESD Sensitivity (ANSI/ESDA/JEDEC JS-001-2012)        | Class 3A                                                       | Class 3A                  | Class 3A                                      | Class 3A         |
| Operating Case Temperature <sup>[1]</sup>            | -40°C to 135°C                                                 | -40°C to 135°C            | -40°C to 120°C                                | -40°C to 110°C   |
| LED Storage Temperature                              | -40°C to 135°C                                                 | -40°C to 135°C            | -40°C to 135°C                                | -40°C to 135°C   |
| Soldering Temperature                                | JEDEC 020c 260°C                                               | JEDEC 020c 260°C          | JEDEC 020c 260°C                              | JEDEC 020c 260°C |
| Allowable Reflow Cycles                              | 3                                                              | 3                         | 3                                             | 3                |
| Autoclave Conditions                                 | -121°C at 2 ATM<br>100% Relative Humidity for 96 Hours Maximum |                           |                                               |                  |
| Reverse Voltage ( $V_{\text{reverse}}$ )             | LUXEON LEDs are not designed to be driven in reverse bias      |                           |                                               |                  |

**Notes for Table 4a:**

1. Proper current derating must be observed to maintain the junction temperature below the maximum.
2. 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  $\leq 15\%$  of the maximum allowable DC forward current 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  $\leq 5\text{ms}$  per cycle and the duty cycle is  $\leq 50\%$ .

Table 4b. Absolute maximum ratings for LUXEON Rebel Color Line at  $T_J=85^{\circ}\text{C}$ .

| PARAMETER                                            | LIME                                                      |
|------------------------------------------------------|-----------------------------------------------------------|
| DC Forward Current <sup>[1,2]</sup>                  | 1000                                                      |
| Peak Pulsed Forward Current <sup>[1,3]</sup>         | 1200                                                      |
| LED Junction Temperature <sup>[1]</sup> (DC & Pulse) | 150°C                                                     |
| ESD Sensitivity (ANSI/ESDA/JEDEC JS-001-2012)        | Class 3A                                                  |
| Operating Case Temperature <sup>[1]</sup>            | -40°C to 135°C                                            |
| LED Storage Temperature                              | -40°C to 135°C                                            |
| Soldering Temperature                                | JEDEC 020c 260°C                                          |
| Allowable Reflow Cycles                              | 3                                                         |
| Autoclave Conditions                                 | 100% Relative Humidity for 96 Hours Maximum               |
| Reverse Voltage ( $V_{\text{reverse}}$ )             | LUXEON LEDs are not designed to be driven in reverse bias |

**Notes for Table 4b:**

1. Proper current derating must be observed to maintain the junction temperature below the maximum.
2. 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  $\leq 15\%$  of the maximum allowable DC forward current 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  $\leq 5\text{ms}$  per cycle and the duty cycle is  $\leq 50\%$ .

# Characteristic Curves

## Spectral Power Distribution Characteristics

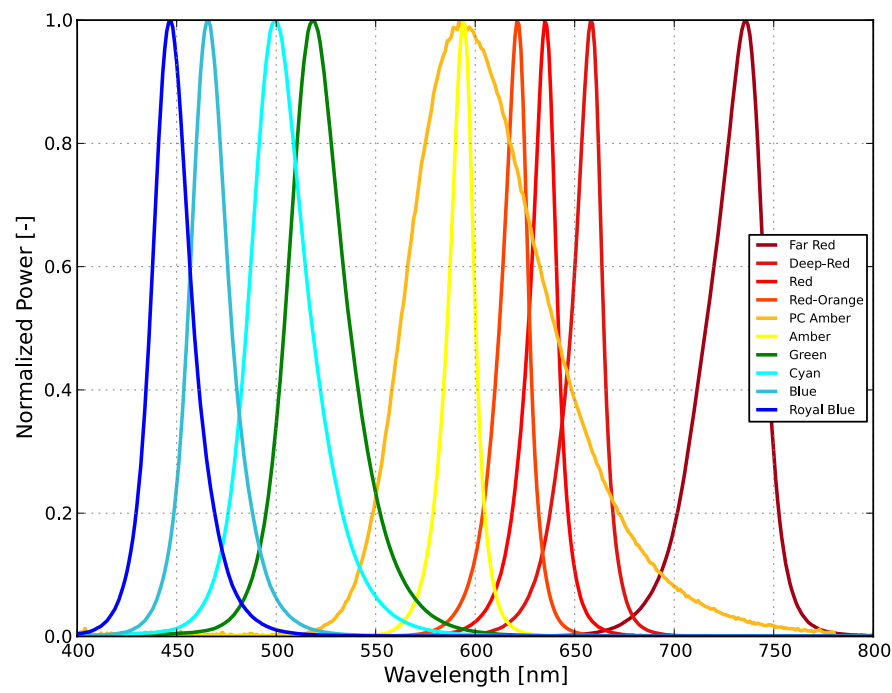


Figure 1a. Typical normalized power vs. wavelength for LUXEON Rebel Far Red, Deep Red, Red, Red-Orange, PC Amber, Amber, Green, Cyan, Blue and Royal Blue at test current,  $T_j=25^{\circ}\text{C}$ .

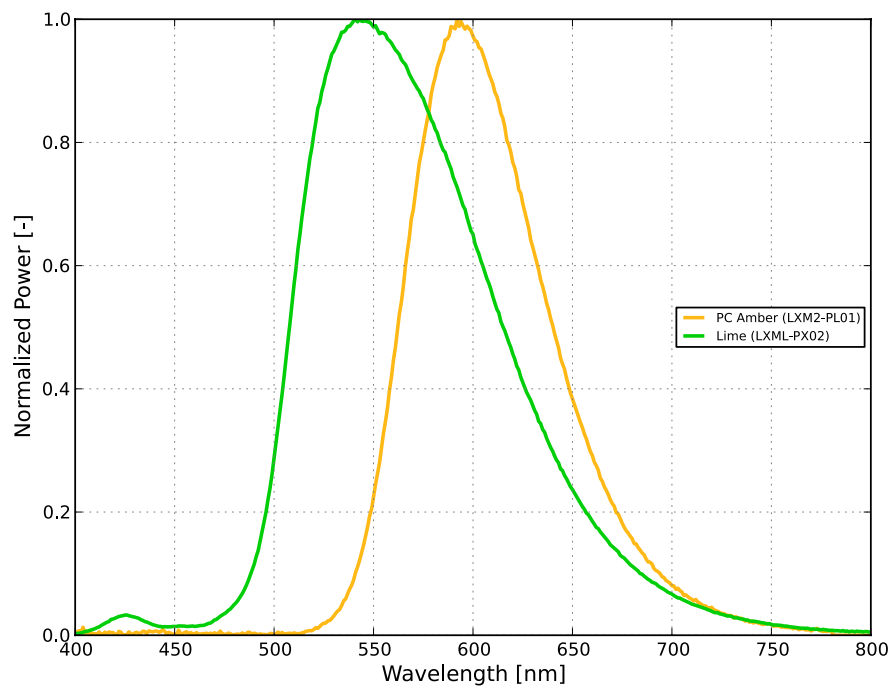


Figure 1b. Typical normalized power vs. wavelength for LUXEON Rebel PC Amber and Lime at 350mA, test temperature.

# Light Output Characteristics

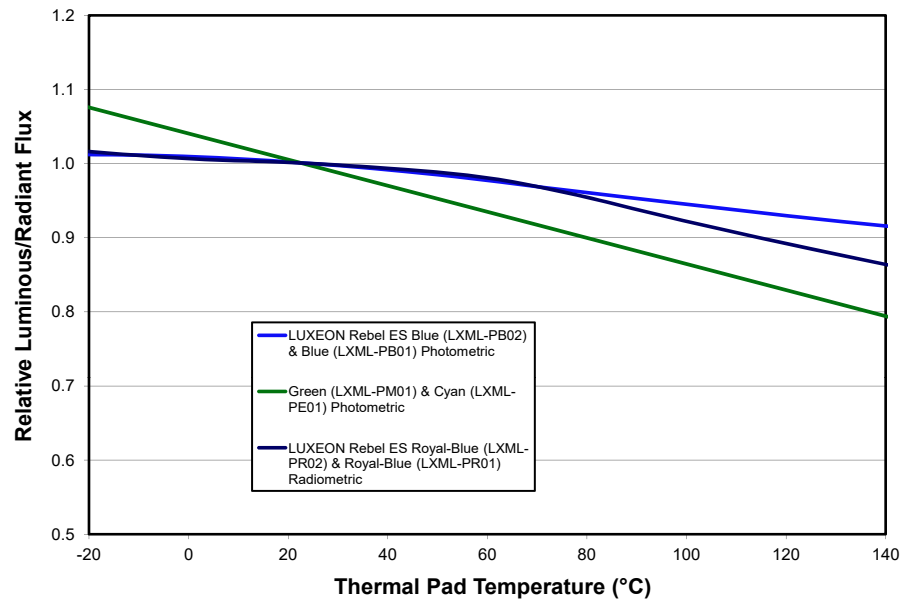


Figure 2a. Typical normalized light output vs. junction temperature for LXML-PM01, LXML-PE01, LXML-PB01, LXML-PB02, LXML-PR01 and LXML-PR02 at test current.

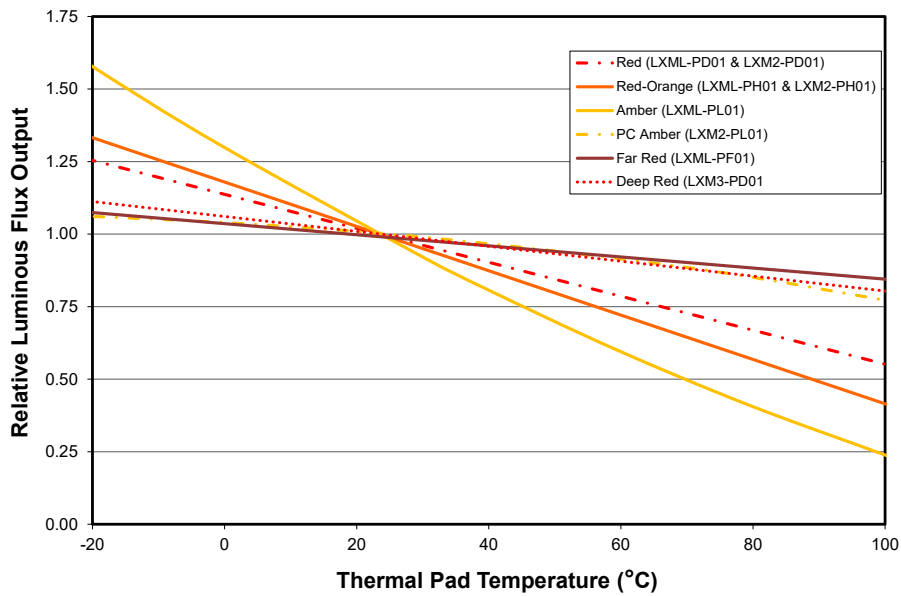


Figure 2b. Typical normalized light output vs. junction temperature for LXML-PF01, LXM3-PD01, LXM2-PD01, LXML-PD01, LXM2-PH01, LXML-PH01, LXM2-PL01, LXML-PL01 at test current.



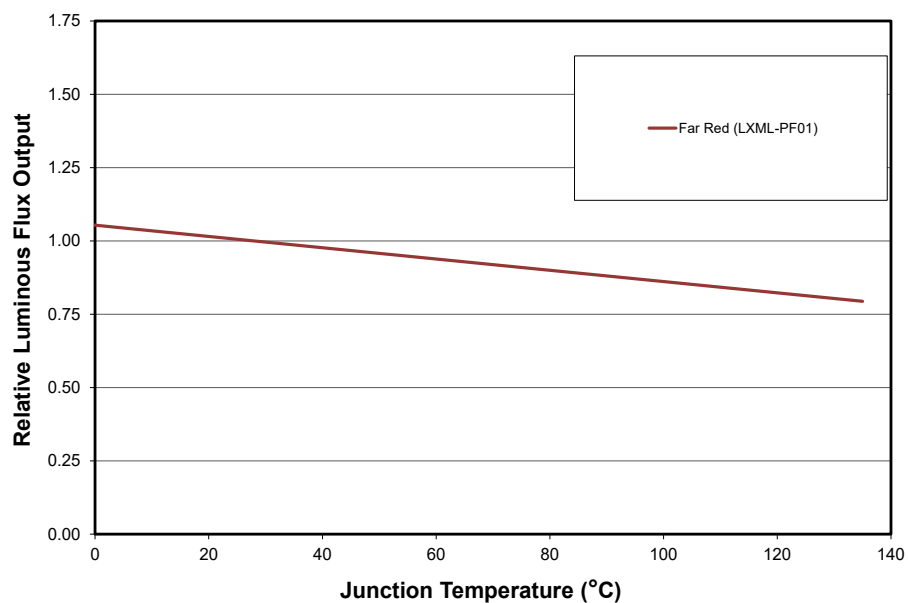


Figure 2c. Typical normalized light output vs. junction temperature for LXML-PF01 at test current.

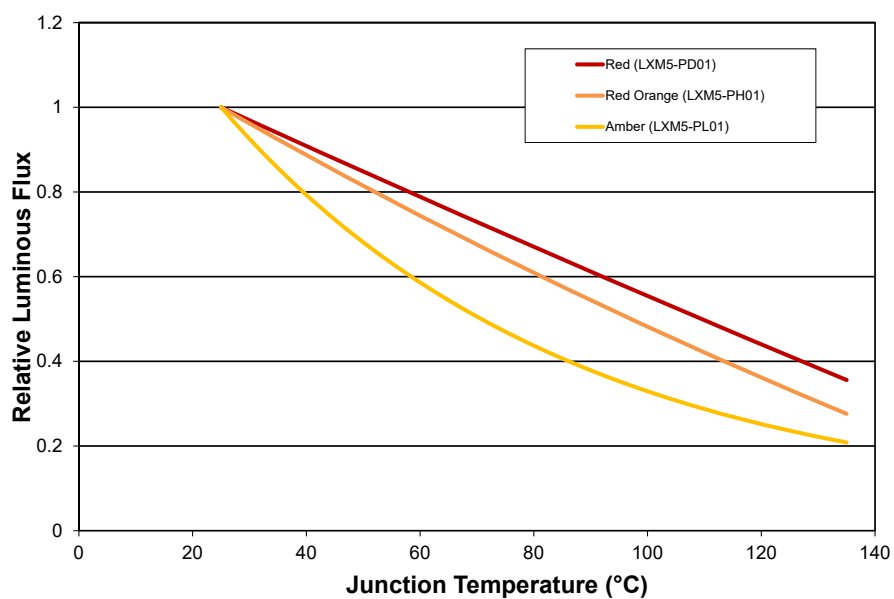


Figure 2d. Typical normalized light output vs. junction temperature for LXM5-PD01, LXM5-PH01 and LXM5-PL01 at test current.

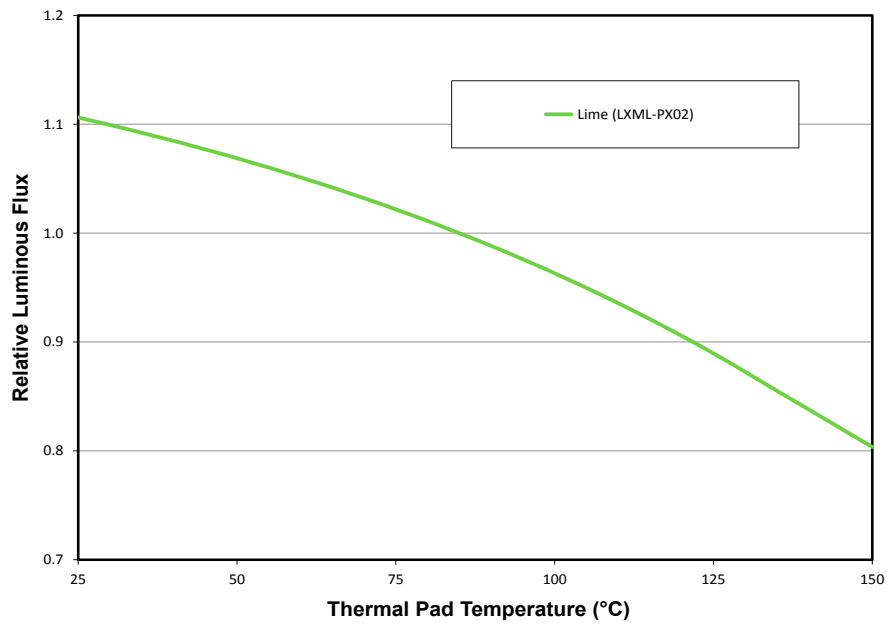


Figure 2e. Typical normalized light output vs. junction temperature for LXML-PX02 at test current.

## Forward Current Characteristics

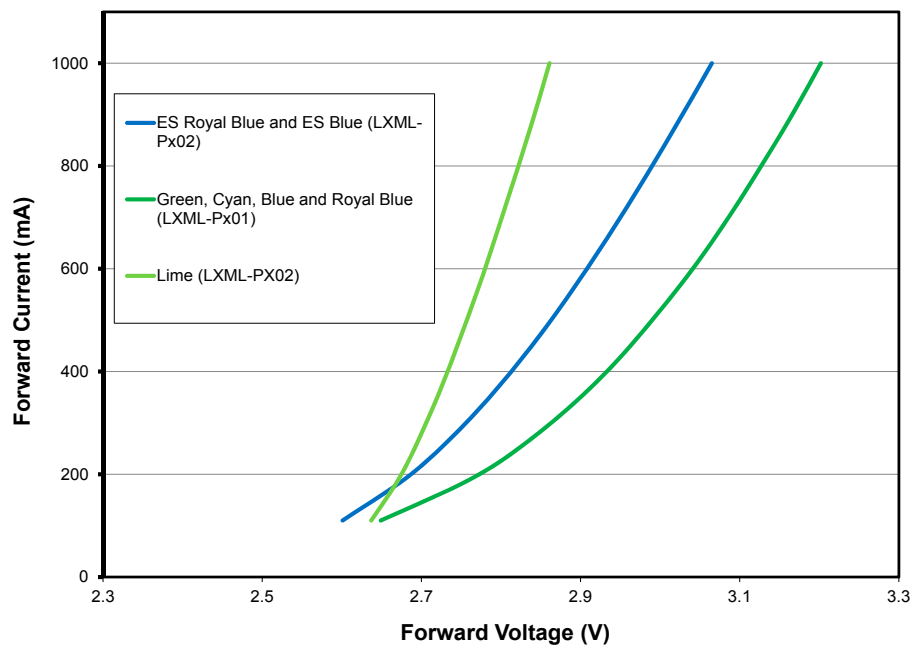


Figure 3a. Typical forward current vs. forward voltage for LXML-PX02, LXML-Px01 and LXML-Px02 at test temperature.

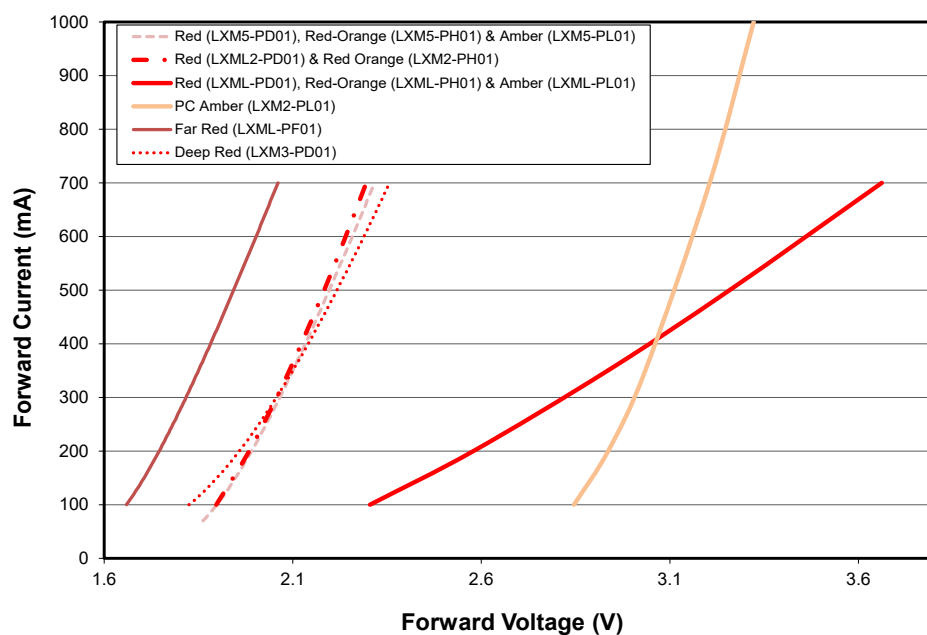


Figure 3b. Typical forward current vs. forward voltage for LXML-PF01, LXM3-PD01, LXM2-PD01, LXM5-PD01, LXML-PD01, LXM2-PH01, LXM5-PH01, LXML-PH01, LXM2-PL01, LXM5-PL01 and LXML-PL01 at test temperature.

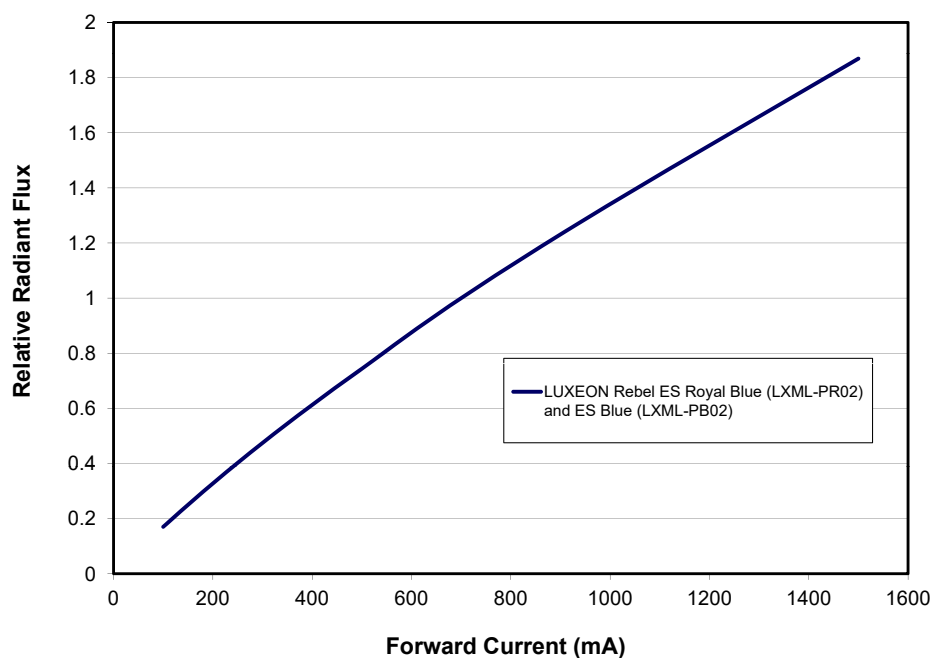


Figure 3c. Relative luminous flux or radiometric power vs. forward current for LXML-PB02 and LXML-PR02 at test temperature.

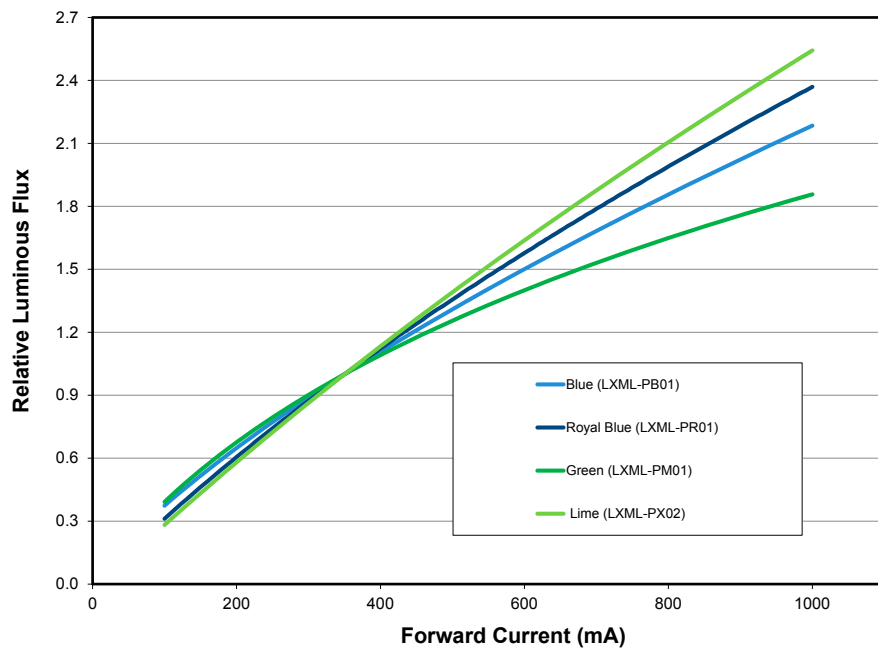


Figure 3d. Relative luminous flux vs. forward current for LXML-PX02, LXML-PM01, LXML-PB01 and LXML-PR01 at test temperature.

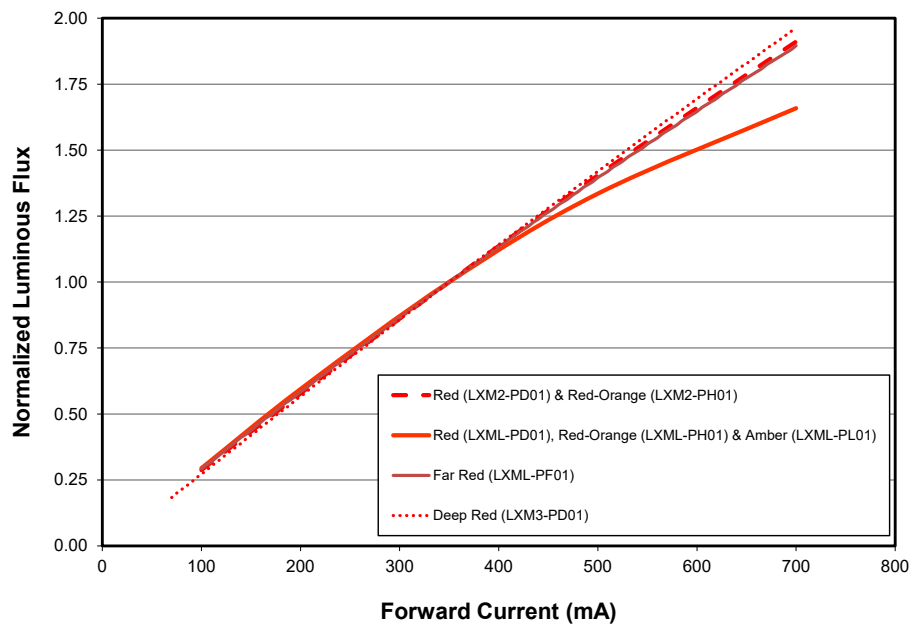


Figure 3e. Normalized luminous flux or radiometric power vs. forward current for LXML-PF01, LXM3-PD01, LXM2-PD01, LXM5-PD01, LXML-PD01, LXM2-PH01, LXM5-PH01, LXML-PH01, LXM5-PL01 and LXML-PL01 at test temperature.

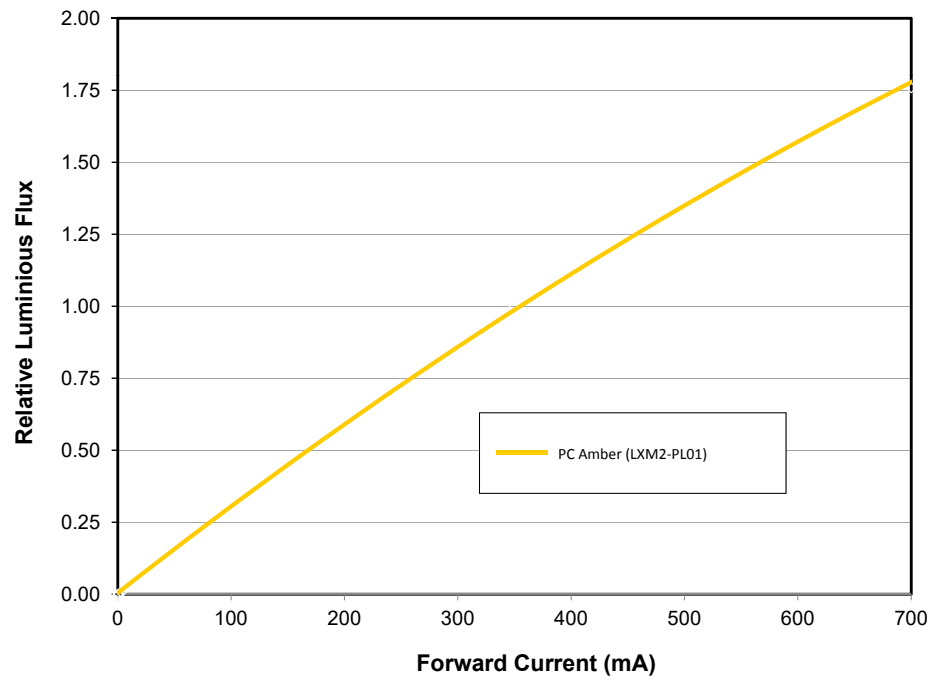


Figure 3f. Relative luminous flux vs. forward current for LXM2-PL01 at test temperature.

# Radiation Pattern Characteristics

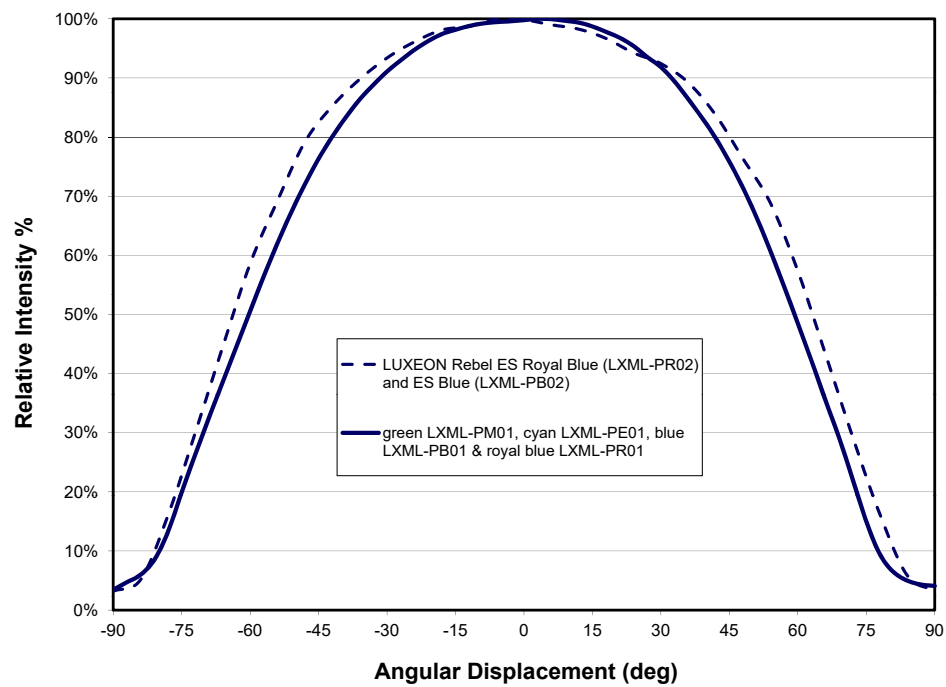


Figure 4a. Typical radiation pattern for LXML-PM01, LXML-PE01, LXML-PB01, LXML-PB02, LXML-PR01 and LXML-PR02 at test conditions.

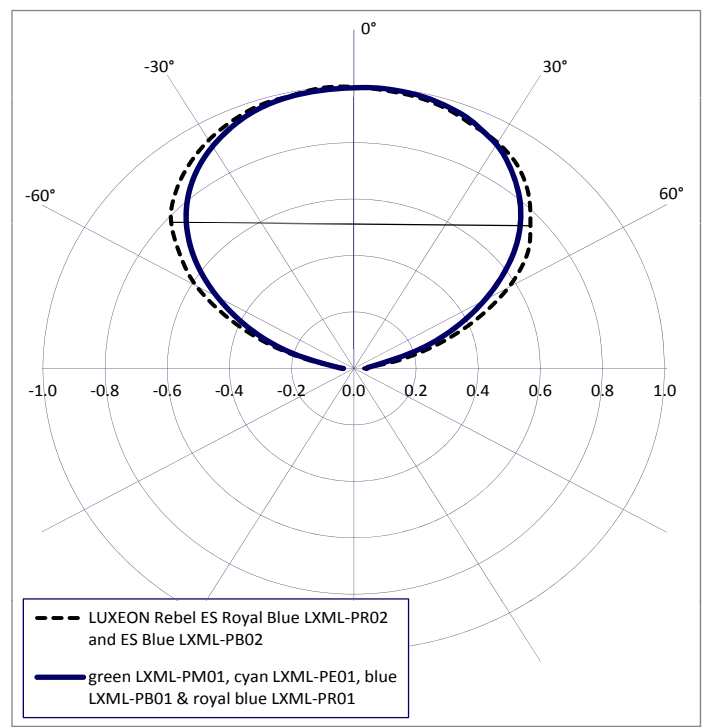


Figure 5a. Typical polar radiation pattern for LXML-PM01, LXML-PE01, LXML-PB01, LXML-PB02, LXML-PR01 and LXML-PR02 at test conditions.

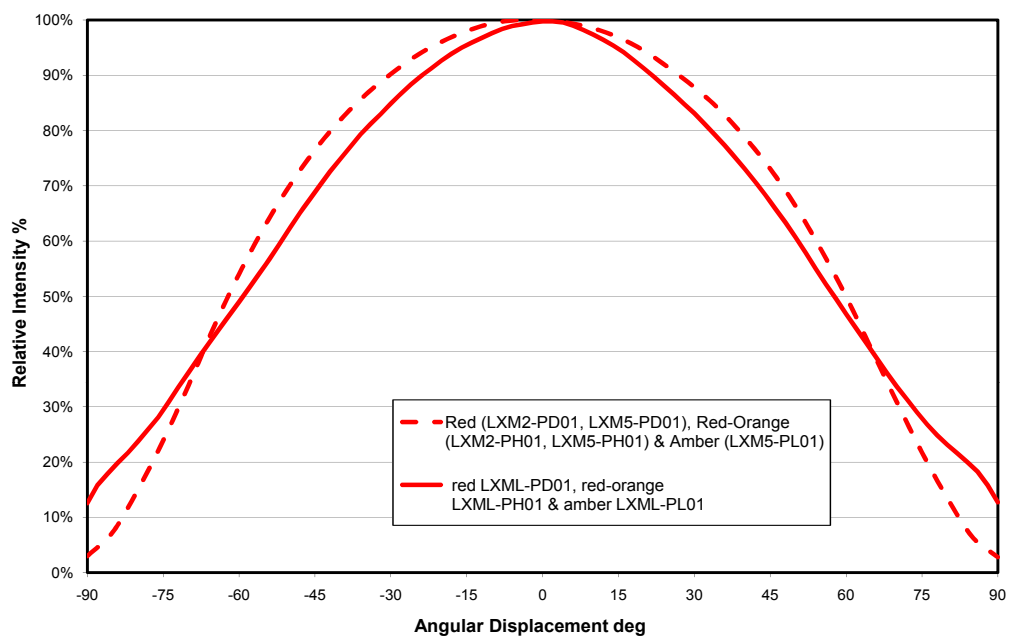


Figure 4b. Typical radiation pattern for LXM2-PD01, LXM5-PD01, LXML-PD01, LXM2-PH01, LXM5-PH01, LXML-PH01, LXM5-PL01 and LXML-PL01 at test conditions.

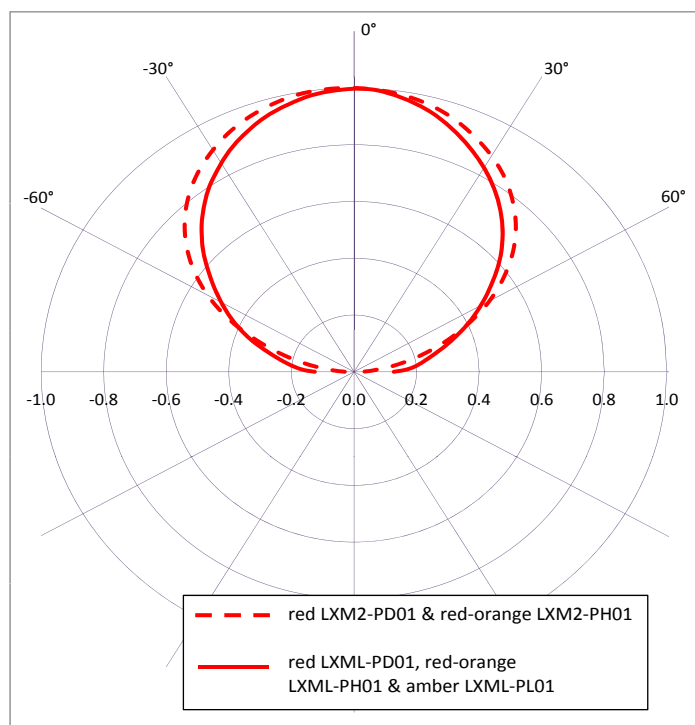


Figure 5b. Typical polar radiation pattern for LXM2-PD01, LXML-PD01, LXM2-PH01, LXML-PH01 and LXML-PL01 at test conditions.

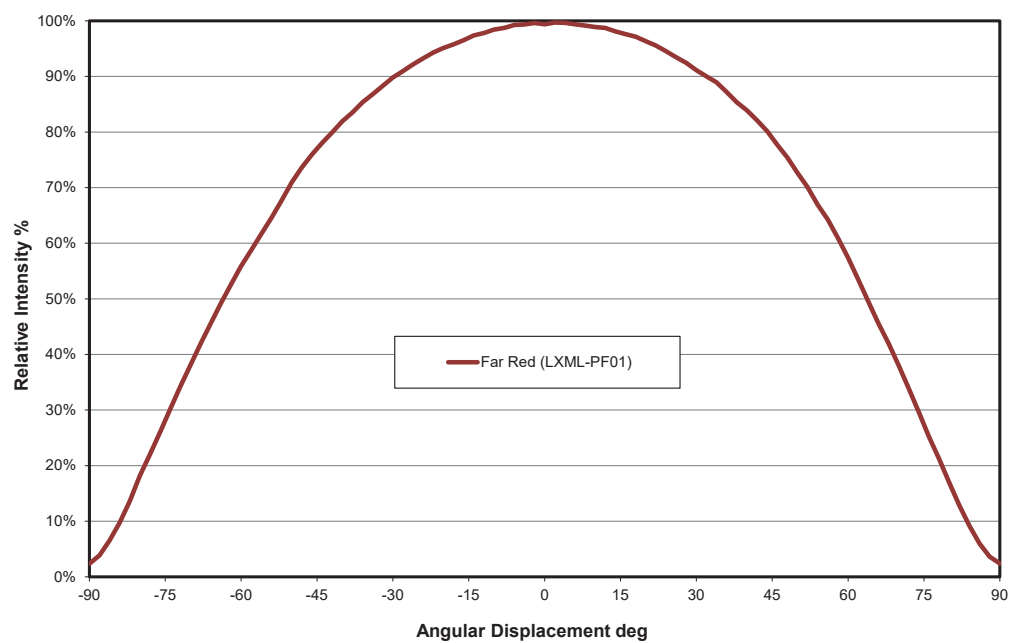


Figure 4c. Typical radiation pattern for LXML-PF01 at test conditions.

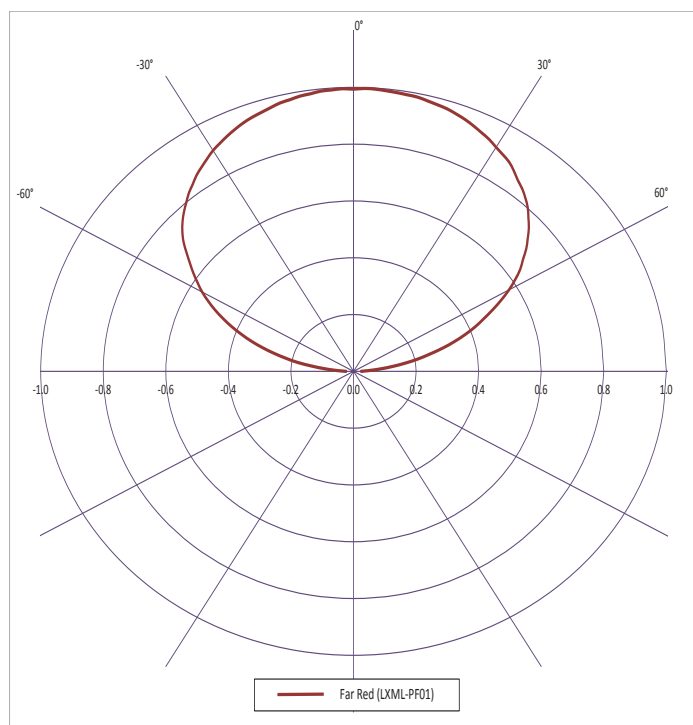


Figure 5c. Typical polar radiation pattern for LXML-PF01 at test conditions.



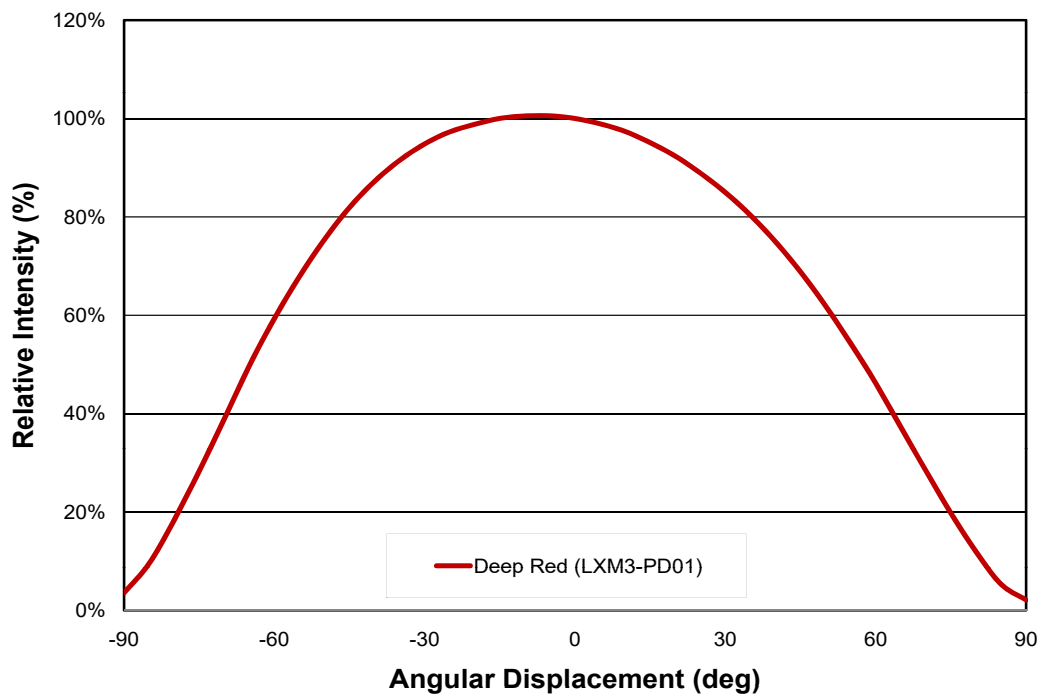


Figure 4d. Typical radiation pattern for LXM3-PD01 at test conditions.

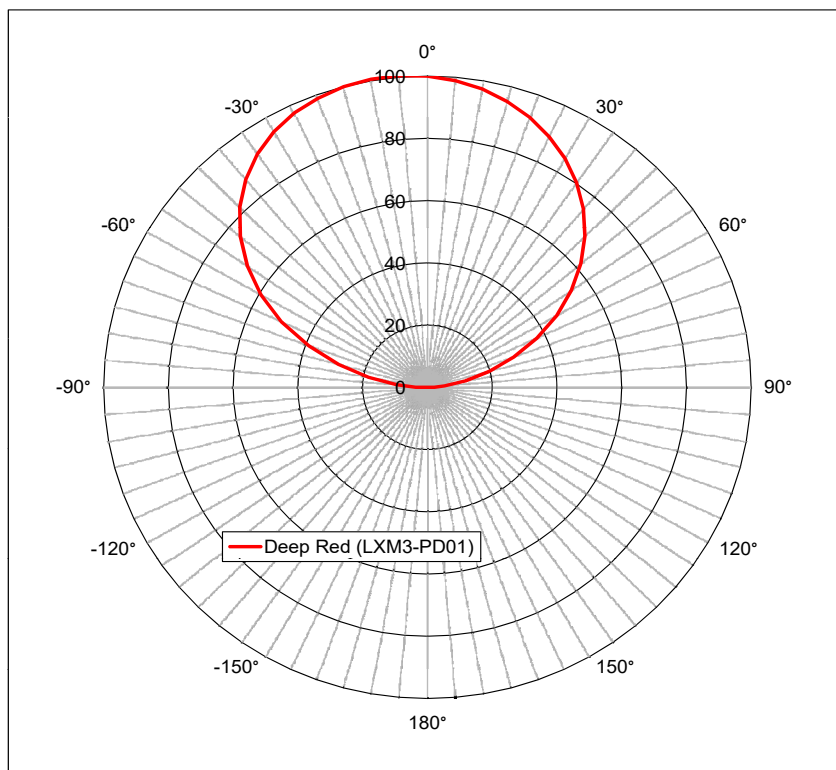


Figure 5d. Typical polar radiation pattern for LXM3-PD01 at test conditions.

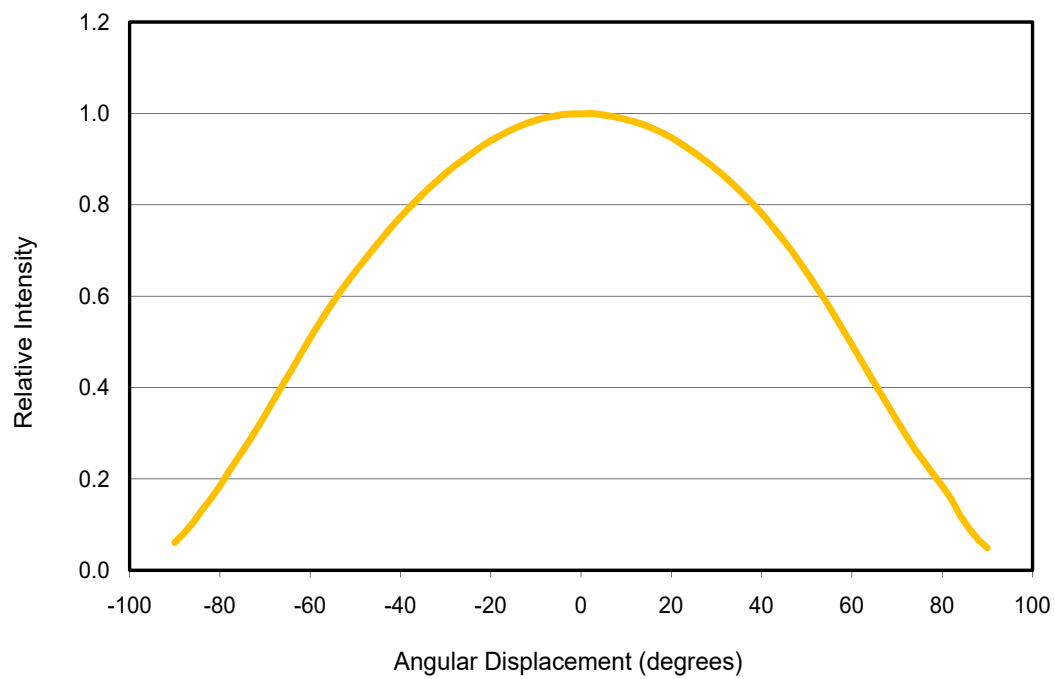


Figure 4e. Typical radiation pattern for LXM2-PL01 at test conditions.

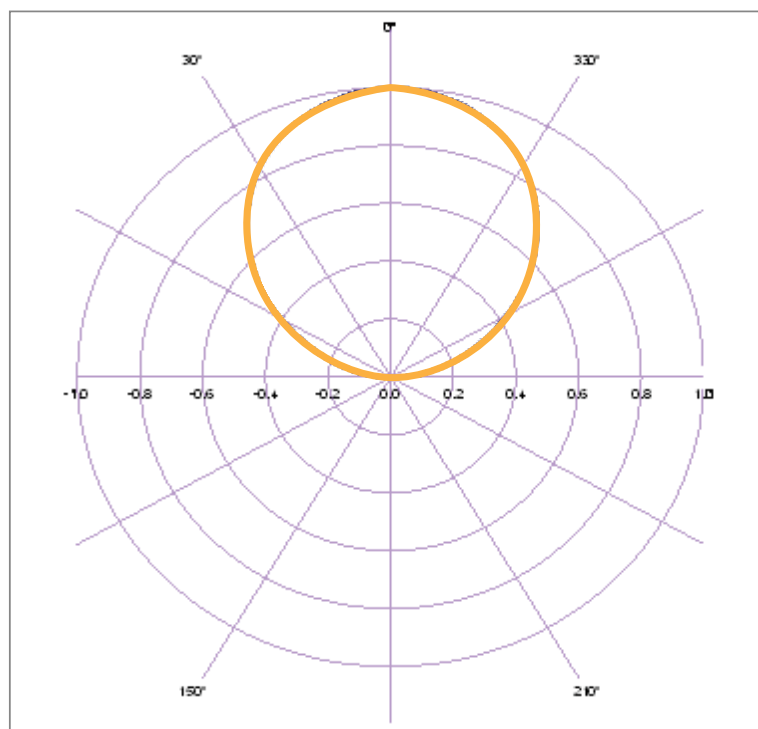


Figure 5e. Typical polar radiation pattern for LXM2-PL01 at test conditions.

# 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.

Reels of LUXEON Rebel Far Red, Deep Red, Red, Red-Orange, PC Amber, Amber, Green, Cyan, Blue and Royal Blue are labeled using a 3-digit alphanumeric CAT code following the format below:

**A B C**

Where:

- A** – designates luminous flux or radiometric power bin (example: Deep Red D=300 to 350 lumens, Green K=70 to 80 lumens)
- B** – designates peak or dominant wavelength bin (example: Green 2=525 to 530nm, Cyan 2=495 to 500nm)
- C** – designates forward voltage bin (example: Far Red U=1.60 to 1.80V, Green B=2.55 to 2.79V)

Therefore, LUXEON Rebel Green with a lumen range of 70 to 80, a dominant wavelength of 525 to 530nm and a forward voltage range of 2.55 to 2.79V has the following CAT code:

**K 2 B**

Reels of LUXEON Rebel Lime are labeled using a 4-digit alphanumeric CAT code following the format below:

**A B C D**

Where:

- A** – designates luminous flux bin (example: F=150 to 160 lumens, J=180 to 190 lumens, M=210 to 220 lumens)
- B C** – designates color bin (example: A0)
- D** – designates forward voltage bin (example: P=2.60 to 2.75V, R=2.75 to 3.00V)

Therefore, LUXEON Rebel Lime with a lumen range of 180 to 190, color bin A0 and a forward voltage range of 2.75 to 3.00V has the following CAT code:

**J A 0 R**

## Luminous Flux Bins

Tables 5a and 5b list the standard luminous flux bins for LUXEON Rebel Color Line emitters. 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 CCTs.

**Table 5a. Luminous flux bin definitions for LUXEON Rebel Red, Red-Orange, PC Amber, Amber, Green, Cyan and Blue.**

| BIN | LUMINOUS FLUX <sup>[1]</sup> (lm) |         |
|-----|-----------------------------------|---------|
|     | MINIMUM                           | MAXIMUM |
| D   | 18                                | 24      |
| E   | 24                                | 30      |
| F   | 30                                | 40      |
| G   | 40                                | 50      |
| H   | 50                                | 60      |
| J   | 60                                | 70      |
| K   | 70                                | 80      |
| L   | 80                                | 90      |
| M   | 90                                | 100     |
| N   | 100                               | 110     |
| X   | 110                               | 120     |
| P   | 120                               | 130     |
| Y   | 130                               | 140     |
| Q   | 140                               | 160     |
| R   | 160                               | 180     |
| S   | 180                               | 200     |

Notes for Table 5a:

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux measurements.
2. Tested and binned at test conditions.

**Table 5b. Luminous flux bin definitions for LUXEON Rebel Lime.**

| BIN | LUMINOUS FLUX <sup>[1]</sup> (lm) |         |
|-----|-----------------------------------|---------|
|     | MINIMUM                           | MAXIMUM |
| E   | 140                               | 150     |
| F   | 150                               | 160     |
| G   | 160                               | 170     |
| H   | 170                               | 180     |
| J   | 180                               | 190     |
| K   | 190                               | 200     |
| L   | 200                               | 210     |
| M   | 210                               | 220     |

Notes for Table 5b:

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux measurements.
2. Tested and binned at test conditions.

## Radiometric Power Bins

Table 6a. Radiometric power bin definitions for LUXEON Rebel Royal Blue.

| BIN | RADIOMETRIC POWER <sup>[1]</sup> (mW) |         |
|-----|---------------------------------------|---------|
|     | MINIMUM                               | MAXIMUM |
| D   | 350                                   | 425     |
| E   | 425                                   | 500     |
| F   | 500                                   | 600     |
| G   | 600                                   | 700     |
| H   | 700                                   | 800     |
| J   | 800                                   | 900     |
| K   | 900                                   | 950     |
| Y   | 950                                   | 1000    |
| A   | 1000                                  | 1050    |
| B   | 1050                                  | 1100    |
| M   | 1100                                  | 1200    |
| N   | 1200                                  | 1300    |
| P   | 1300                                  | 1400    |

**Notes for Table 6a:**

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  for radiometric power measurements.
2. Tested and binned at test conditions.

Table 6b. Radiometric power bin definitions for LUXEON Rebel Far Red and Deep Red.

| BIN | RADIOMETRIC POWER <sup>[1]</sup> (mW) |         |
|-----|---------------------------------------|---------|
|     | MINIMUM                               | MAXIMUM |
| B   | 210                                   | 260     |
| C   | 260                                   | 300     |
| D   | 300                                   | 350     |
| E   | 350                                   | 400     |

**Notes for Table 6b:**

1. Lumileds maintains a tolerance of  $\pm 6.5\%$  for radiometric power measurements.
2. Tested and binned at test conditions.

## Dominant and Peak Wavelength Bins

Table 7a. Dominant wavelength bin definitions for LUXEON Rebel Red, Red-Orange, Amber, Green, Cyan and Blue.

| COLOR      | PART NUMBER                           | BIN | DOMINANT WAVELENGTH <sup>[1]</sup> (nm) |         |
|------------|---------------------------------------|-----|-----------------------------------------|---------|
|            |                                       |     | MINIMUM                                 | MAXIMUM |
| Red        | LXM2-PD01, LXM5-PD01<br>and LXML-PD01 | 4   | 620                                     | 630     |
|            |                                       | 5   | 630                                     | 645     |
| Red-Orange | LXM2-PH01, LXM5-PH01<br>and LXML-PH01 | 2   | 610                                     | 620     |
| Amber      | LXM5-PL01<br>and LXML-PL01            | 1   | 585                                     | 587     |
|            |                                       | 2   | 587                                     | 590     |
|            |                                       | 4   | 590                                     | 592     |
|            |                                       | 6   | 592                                     | 595     |
| Green      | LXML-PM01                             | 1   | 520                                     | 525     |
|            |                                       | 2   | 525                                     | 530     |
|            |                                       | 3   | 530                                     | 535     |
|            |                                       | 4   | 535                                     | 540     |
| Cyan       | LXML-PE01                             | 1   | 490                                     | 495     |
|            |                                       | 2   | 495                                     | 500     |
|            |                                       | 3   | 500                                     | 505     |
|            |                                       | 4   | 505                                     | 510     |
|            |                                       | 5   | 510                                     | 515     |
| Blue       | LXML-PB01<br>and LXML-PB02            | 1   | 460                                     | 465     |
|            |                                       | 2   | 465                                     | 470     |
|            |                                       | 3   | 470                                     | 475     |
|            |                                       | 4   | 475                                     | 480     |
|            |                                       | 5   | 480                                     | 485     |

**Notes for Table 7a:**

1. Lumileds maintains a tolerance of  $\pm 0.5\text{nm}$  for dominant wavelength measurements.

Table 7b. Peak wavelength bin definitions for LUXEON Rebel Far Red, Deep Red and Royal Blue.

| COLOR      | PART NUMBER                   | BIN | PEAK WAVELENGTH <sup>[1]</sup> (nm) |         |
|------------|-------------------------------|-----|-------------------------------------|---------|
|            |                               |     | MINIMUM                             | MAXIMUM |
| Far Red    | LXML-PF01                     | 1   | 720                                 | 730     |
|            |                               | 2   | 730                                 | 740     |
|            |                               | 3   | 740                                 | 750     |
| Deep Red   | LXM3-PD01                     | 6   | 650                                 | 660     |
|            |                               | 7   | 660                                 | 670     |
| Royal Blue | LXML-PR01<br>and<br>LXML-PR02 | 3   | 440                                 | 445     |
|            |                               | 4   | 445                                 | 450     |
|            |                               | 5   | 450                                 | 455     |
|            |                               | 6   | 455                                 | 460     |

**Notes for Table 7b:**

1. Lumileds maintains a tolerance of  $\pm 2\text{nm}$  for peak wavelength measurements.

# Color Bin Definitions

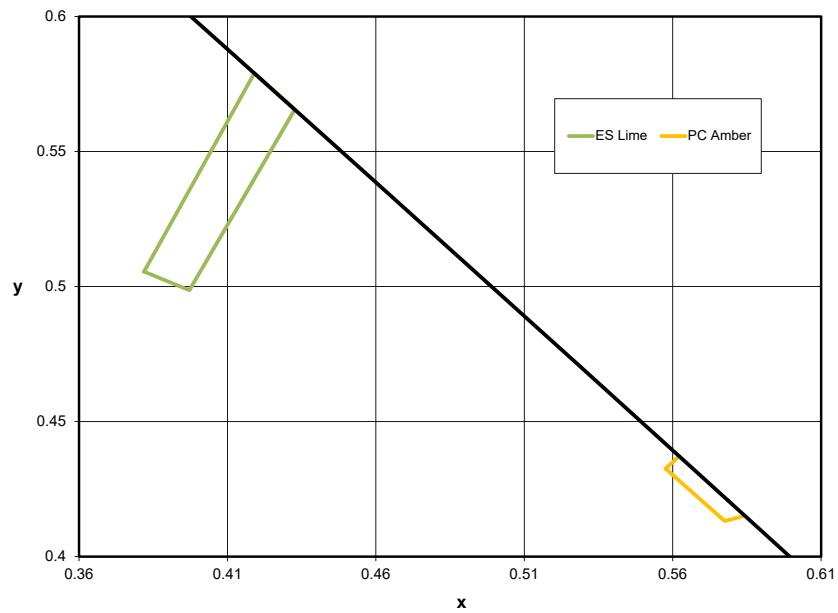


Figure 6. Color bin structure for LUXEON Rebel PC Amber and Lime for Table 8.

Table 8. Peak wavelength bin definitions for LUXEON Rebel PC Amber and Lime.

| COLOR    | PART NUMBER | BIN | x      | y      |
|----------|-------------|-----|--------|--------|
| PC Amber | LXM2-PL01   | 2   | 0.5622 | 0.4372 |
|          |             |     | 0.5576 | 0.4326 |
|          |             |     | 0.5775 | 0.4132 |
|          |             |     | 0.5843 | 0.4151 |
| Lime     | LXML-PX02   | A0  | 0.3819 | 0.5055 |
|          |             |     | 0.4191 | 0.5790 |
|          |             |     | 0.4327 | 0.5655 |
|          |             |     | 0.3972 | 0.4986 |

Notes for Table 8:  
1. Lumileds maintains a tolerance of ±0.005 on x and y coordinates in the CIE 1931 color space.

## Forward Voltage Bins

Table 9. Forward voltage bin definitions for LUXEON Rebel Color Line at test conditions.

| PART NUMBER                                                                                                                                                                   | BIN | FORWARD VOLTAGE <sup>[1]</sup> (V <sub>f</sub> ) |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------------------------------|---------|
|                                                                                                                                                                               |     | MINIMUM                                          | MAXIMUM |
| Far Red - LXML-PF01<br>Deep Red - LXM3-PD01<br>Red - LXM2-PD01<br>Red - LXM5-PD01<br>Red-Orange - LXM2-PH01<br>Red-Orange - LXM5-PH01<br>Amber - LXM5-PL01                    | U   | 1.60                                             | 1.80    |
|                                                                                                                                                                               | V   | 1.80                                             | 2.00    |
|                                                                                                                                                                               | W   | 2.00                                             | 2.20    |
|                                                                                                                                                                               | X   | 2.20                                             | 2.40    |
|                                                                                                                                                                               | Y   | 2.40                                             | 2.60    |
|                                                                                                                                                                               | Z   | 2.60                                             | 2.80    |
|                                                                                                                                                                               |     |                                                  |         |
| Lime - LXML-PX02                                                                                                                                                              | P   | 2.60                                             | 2.75    |
|                                                                                                                                                                               | R   | 2.75                                             | 3.00    |
| Red - LXML-PD01<br>Red-Orange - LXML-PH01<br>PC Amber - LXM2-PL01<br>Amber - LXML-PL01<br>Green - LXML-PM01<br>Cyan - LXML-PE01<br>Blue - LXML-PB01<br>Royal Blue - LXML-PR01 | A   | 2.31                                             | 2.55    |
|                                                                                                                                                                               | B   | 2.55                                             | 2.79    |
|                                                                                                                                                                               | C   | 2.79                                             | 3.03    |
|                                                                                                                                                                               | D   | 3.03                                             | 3.27    |
|                                                                                                                                                                               | E   | 3.27                                             | 3.51    |
|                                                                                                                                                                               |     |                                                  |         |
|                                                                                                                                                                               |     |                                                  |         |
| ES Blue - LXML-PB02<br>ES Royal Blue - LXML-PR02                                                                                                                              | P   | 2.50                                             | 2.75    |
|                                                                                                                                                                               | R   | 2.75                                             | 3.00    |
|                                                                                                                                                                               | S   | 3.00                                             | 3.25    |
|                                                                                                                                                                               | T   | 3.25                                             | 3.50    |

**Notes for Table 9:**

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



# Mechanical Dimensions

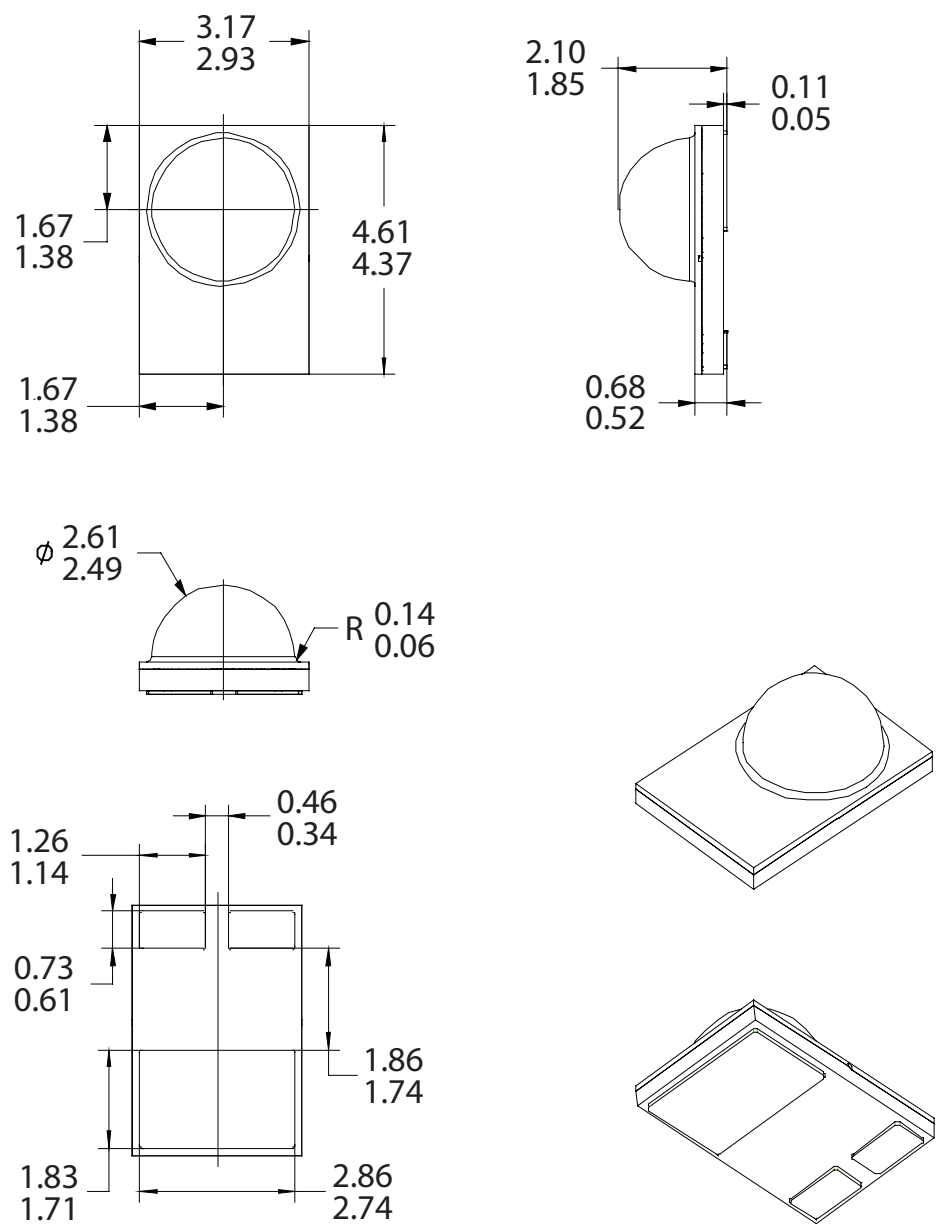


Figure 7a. Mechanical dimensions for LUXEON Rebel Color Line.

Notes for Figure 7a:  
1. Drawings are not to scale.  
2. All dimensions are in millimeters.

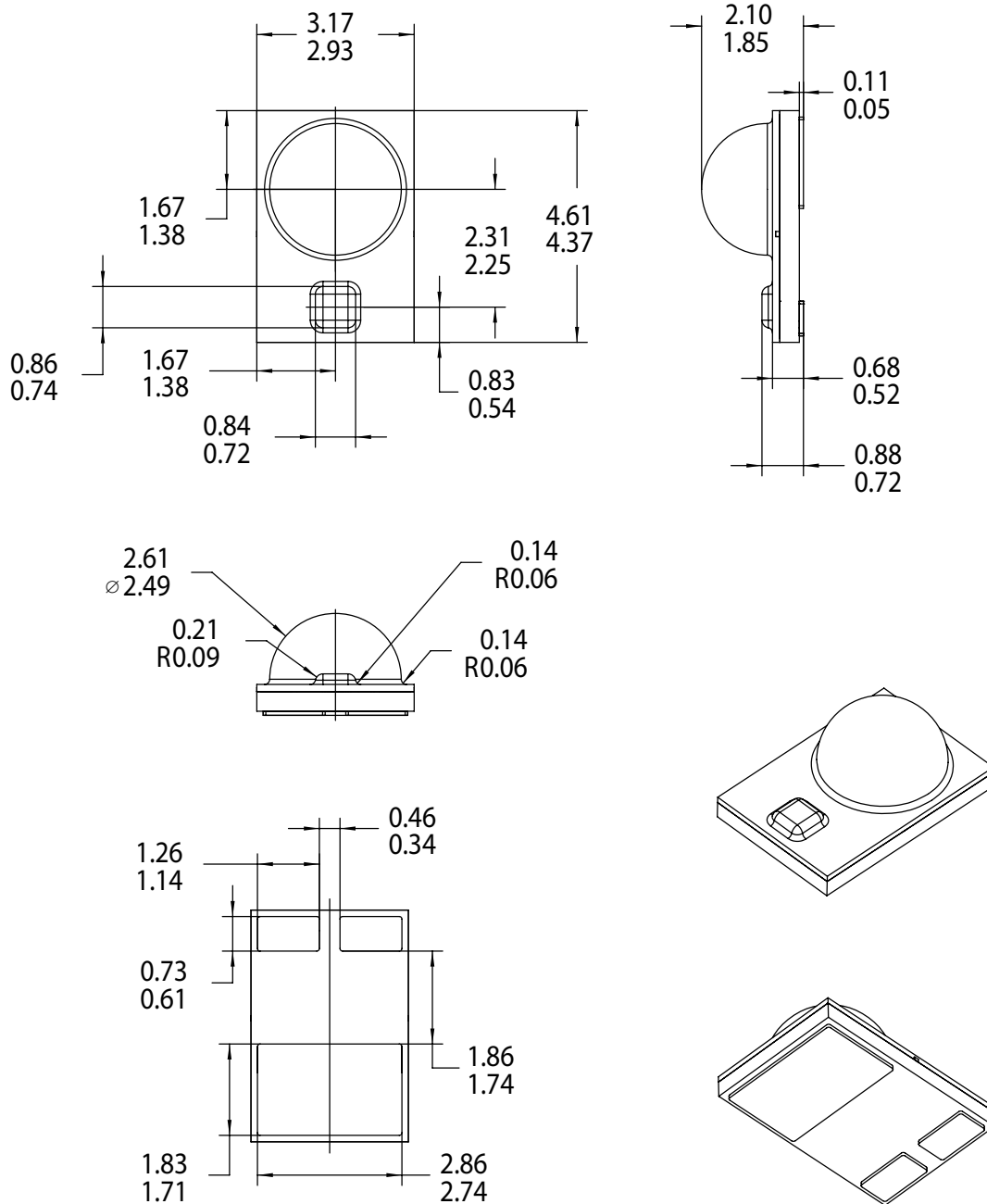


Figure 7b. Mechanical dimensions for LUXEON Rebel ES Blue and LUXEON Rebel ES Royal Blue.

Notes for Figure 7b:

1. Drawings are not to scale.
2. All dimensions are in millimeters.

# Reflow Soldering Guidelines

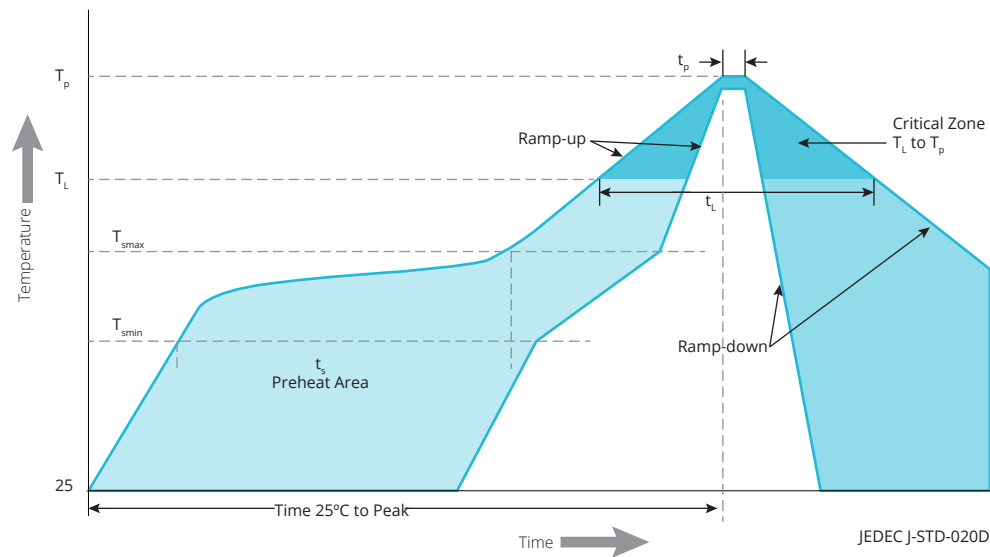


Figure 8. Visualization of the acceptable reflow temperature profile as specified in Table 10.

Table 10. Reflow profile characteristics for LUXEON Rebel Color Line.

| 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 180 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 11. Moisture sensitivity levels for LUXEON Rebel Color Line.

| 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

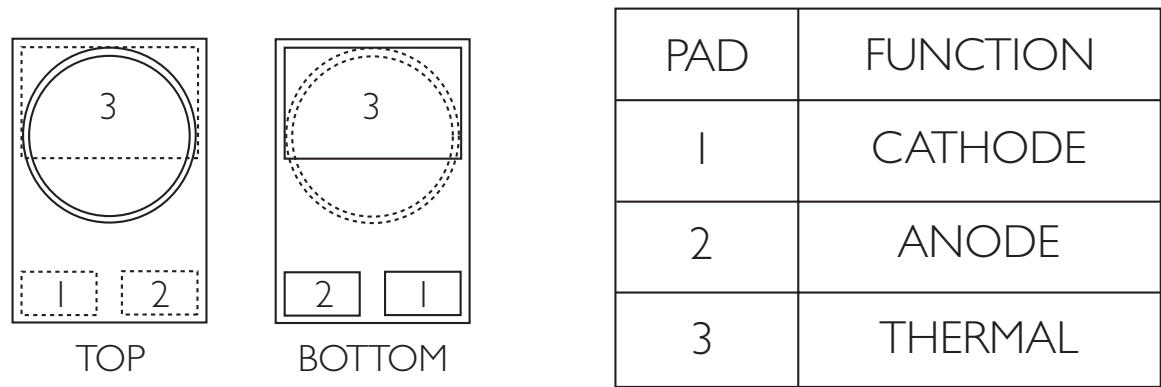


Figure 9a. LUXEON Rebel Color Line pad configuration.

Notes for Figure 9a:

- 1. The Thermal Pad is electrically isolated from the Anode and Cathode contact pads.
- 2. Drawings are not to scale.

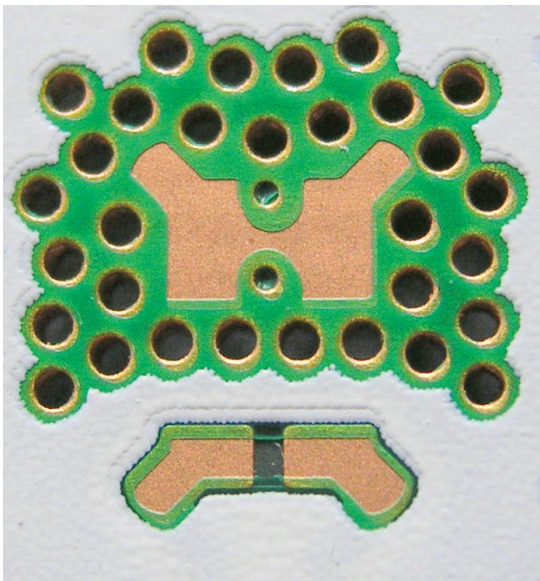


Figure 9b. LUXEON Rebel Color Line solder pad design.

Notes for Figure 9b:

- 3. The photograph shows the recommended LUXEON Rebel Color Portfolio layout on printed circuit board (PCB). This design easily achieves a thermal resistance of 7K/W.
- 4. Drawings are not to scale.

# Packaging Information

## Pocket Tape Dimensions

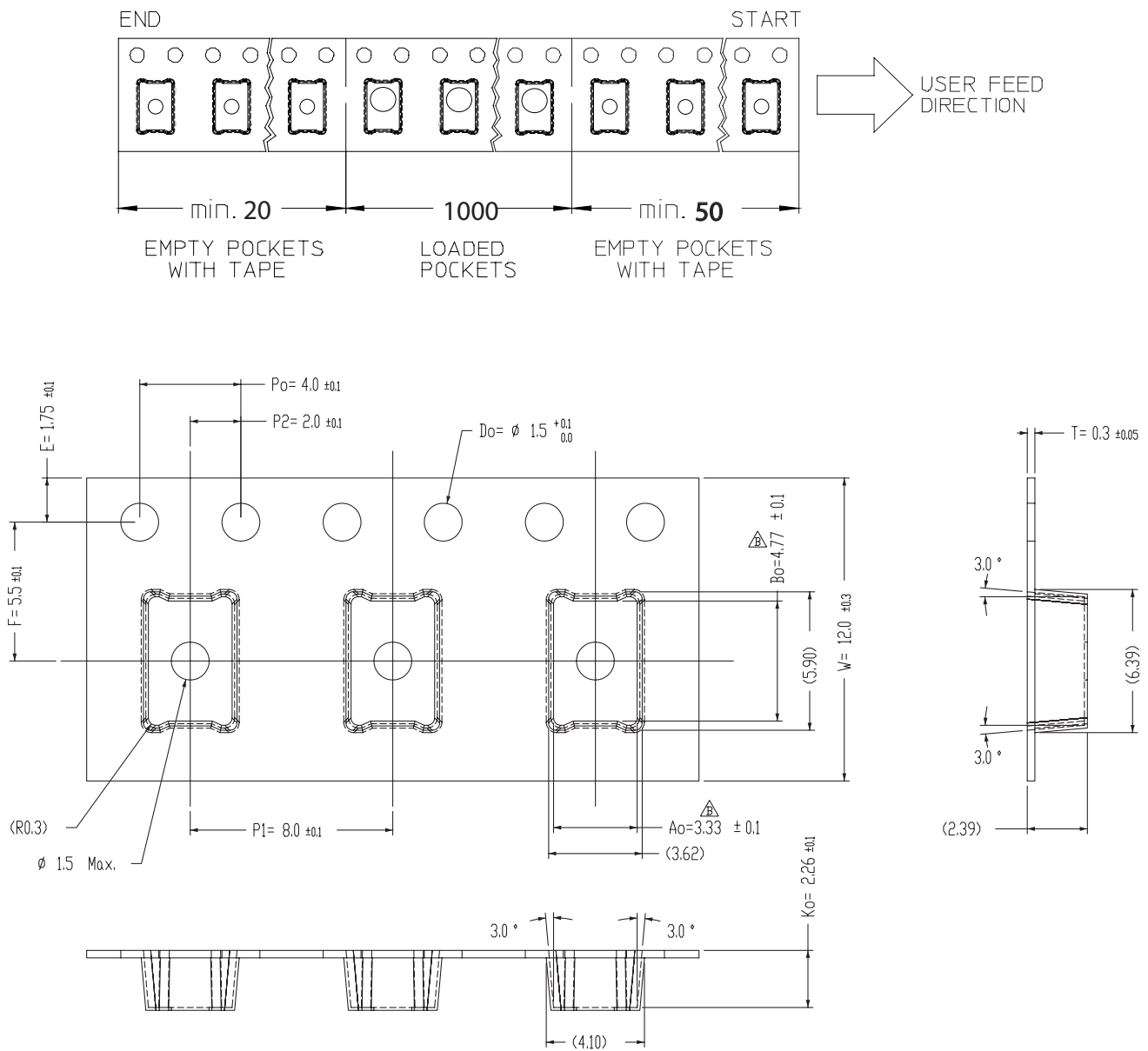


Figure 10. Pocket tape dimensions for LUXEON Rebel Color Line.

### Notes for Figure 10:

1. Drawings are not to scale.
2. All dimensions are in millimeters.

## Reel Dimensions

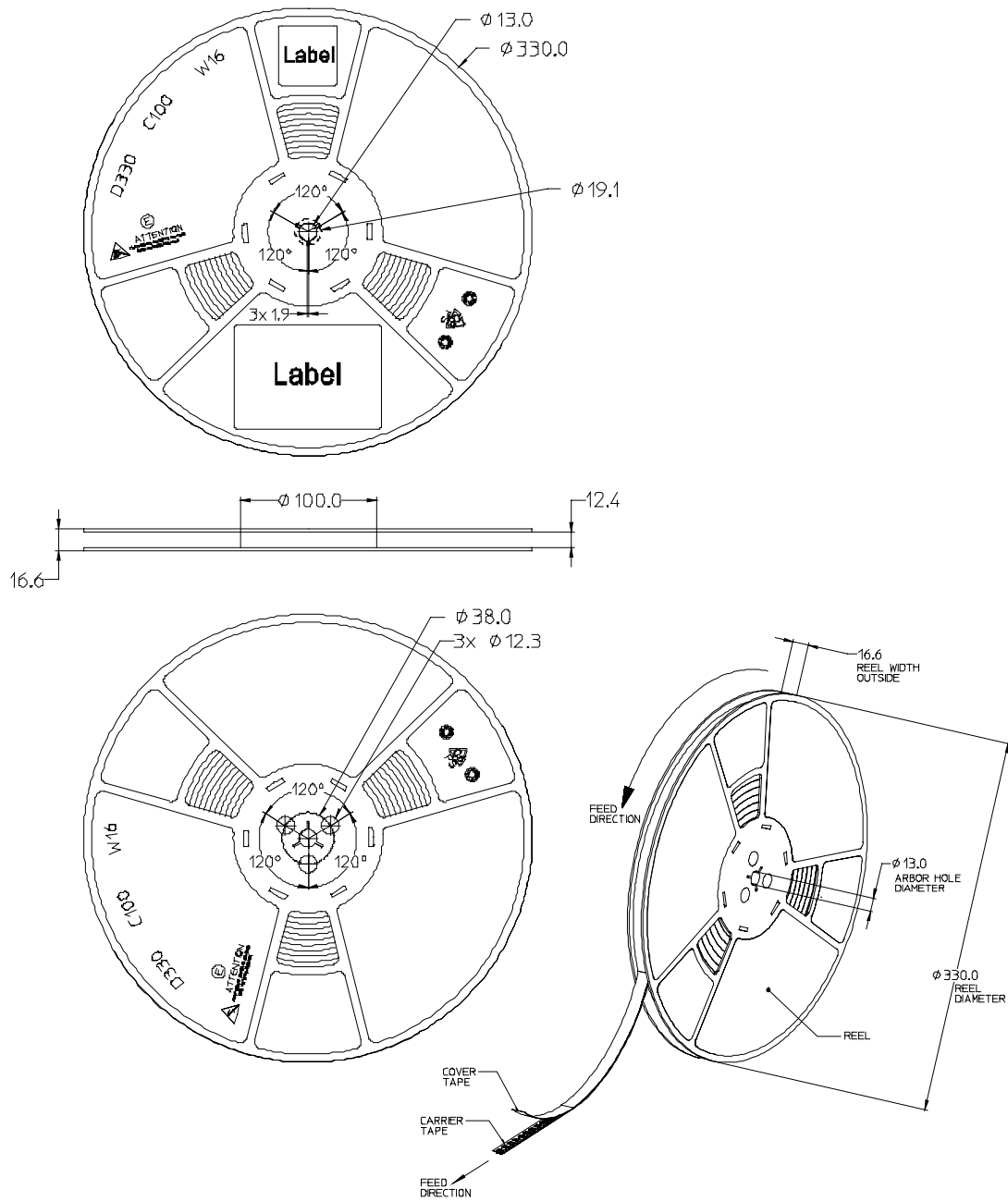


Figure 11. Reel dimensions for LUXEON Rebel Color Line.

### Notes for Figure 11:

1. Drawings are not to scale.
2. All dimensions are in millimeters.

## About Lumileds

Companies developing automotive, mobile, IoT and illumination lighting applications need a partner who can collaborate with them to push the boundaries of light. With over 100 years of inventions and industry firsts, Lumileds is a global lighting solutions company that helps customers around the world deliver differentiated solutions to gain and maintain a competitive edge. As the inventor of Xenon technology, a pioneer in halogen lighting and the leader in high performance LEDs, Lumileds builds innovation, quality and reliability into its technology, products and every customer engagement. Together with its customers, Lumileds is making the world safer, better and more beautiful—with light.

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