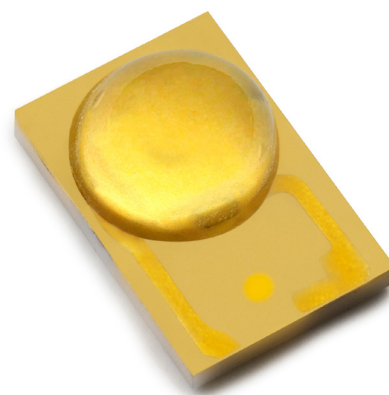




# LUXEON Rebel PLUS

## The original high-power LED

LUXEON Rebel PLUS is designed with the highest possible efficacy and light output from an industry standard 4530 package with a 2.5mm<sup>2</sup> dome. With hot testing and color binning, every LUXEON Rebel PLUS is tested and specified at real world operating conditions — 85°C. Our exceptional color control enables design simplicity for luminaire manufacturers and ensures that they can be confident in color consistency from LED to LED. The superior quality of light, light output, and real world efficacy enable leading performance and efficient solution development in a wide variety of outdoor and industry lighting segments.



### FEATURES AND BENEFITS

3- & 5-step MacAdam ellipse: *Freedom from Binning* for superior quality of light

Ability to deliver high Lm/\$ for Indoor applications

Low typical  $V_f \sim 2.8V$

Small optical source size

Full range of CCTS in 80CRI minimum

LM-80 test report available

### PRIMARY APPLICATIONS

High Bay & Low Bay

Outdoor

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# General Information

## Part Number Nomenclature

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

The part number designation for the LUXEON Rebel PLUS emitters is explained as follows:

L X 1 8 – P 1 X X – Y

Where:

8 — designates minimum CRI performance (value 8 = 80 minimum)

P — designates radiation pattern (value P for Lambertian)

1 — 80 CRI min designation

XX — designates nominal ANSI CCT (value 27 = 2700K, 30 = 3000K, 35 = 3500K, 40 = 4000K, and 50 = 5000K)

Y — 3 for 3-step and 5-step MacAdam Ellipse

## Lumen Maintenance

LUXEON Rebel PLUS products are tested in compliance with LM-80. Please visit [www.lumileds.com](http://www.lumileds.com) or contact your local Lumileds Technical Solutions Manager for TM-21 extrapolations or other support.

## Environmental Compliance

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

# Product Selection & Optical Characteristics

## Product Selection Guide for LUXEON Rebel PLUS Emitters Junction Temperature = 85°C

Table 1.

| Part Number | Nominal ANSI CCT | Performance @ 350mA Test Current |                        |                   | Typ. Luminous Flux (lm) |       | Typ. Forward Voltage (V) |       | Typ. Efficacy (lm/W) |       |
|-------------|------------------|----------------------------------|------------------------|-------------------|-------------------------|-------|--------------------------|-------|----------------------|-------|
|             |                  | CRI Min                          | Min Luminous Flux (lm) | Test Condition °C | 350mA                   | 700mA | 350mA                    | 700mA | 350mA                | 700mA |
| LX18-P127-Y | 2700K            | 80                               | 80                     | 85                | 85                      | 156   | 2.76                     | 2.85  | 88                   | 78    |
| LX18-P130-Y | 3000K            | 80                               | 85                     | 85                | 95                      | 166   | 2.76                     | 2.85  | 98                   | 83    |
| LX18-P135-Y | 3500K            | 80                               | 90                     | 85                | 98                      | 172   | 2.76                     | 2.85  | 101                  | 86    |
| LX18-P140-Y | 4000K            | 80                               | 90                     | 85                | 103                     | 180   | 2.76                     | 2.85  | 107                  | 90    |
| LX18-P150-Y | 5000K            | 80                               | 95                     | 85                | 106                     | 186   | 2.76                     | 2.85  | 110                  | 93    |

Notes for Table 1:

1. Minimum luminous flux performance within published operating conditions. Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux measurements and  $\pm 2$  on CRI measurements.
2. Lumileds maintains a tolerance of  $\pm 0.06V$  on forward voltage measurements.

## Optical Characteristics

### LUXEON Rebel PLUS at Test Current <sup>[1]</sup>, Junction Temperature = 85°C

Table 2.

| Nominal CCT | Part Number | Color Temperature <sup>[2]</sup><br>CCT<br>Typical | Typ Total Included Angle <sup>[2]</sup><br>(degrees) $\theta_{0.90V}$ | Typ Viewing Angle <sup>[3]</sup><br>(degrees) $2\theta_{1/2}$ |
|-------------|-------------|----------------------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------|
| 2700K       | LX18-P127-Y | 2725K                                              | 160                                                                   | 120                                                           |
| 3000K       | LX18-P130-Y | 3045K                                              | 160                                                                   | 120                                                           |
| 3500K       | LX18-P135-Y | 3465K                                              | 160                                                                   | 120                                                           |
| 4000K       | LX18-P140-Y | 3985K                                              | 160                                                                   | 120                                                           |
| 5000K       | LX18-P150-Y | 5028K                                              | 160                                                                   | 120                                                           |

Notes for Table 2:

1. Test current is 350mA D.C. for all LX18-P1xx emitters.
2. Total angle at which 90% of total luminous flux is captured.
3. Viewing angle is the off axis angle from lamp centerline where the luminous intensity is 1/2 of the peak value.

# Electrical Characteristics

## Electrical Characteristics at 350mA for LUXEON Rebel PLUS, Junction Temperature = 85°C

Table 3.

| Nominal<br>ANSI CCT | Forward Voltage $V_f$ <sup>[1]</sup> (V) |      | Typical Temperature Coefficient<br>of Forward Voltage <sup>[2]</sup><br>(mV/°C)<br>$\Delta V_f / \Delta T_j$ | Typical Thermal Resistance<br>Junction to Thermal Pad<br>(°C/W)<br>$R_{\theta J-C}$ |
|---------------------|------------------------------------------|------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                     | Min                                      | Max  |                                                                                                              |                                                                                     |
| 2700K               | 2.5                                      | 3.00 | -1.0 to -3.0                                                                                                 | 9                                                                                   |
| 3000K               | 2.5                                      | 3.00 | -1.0 to -3.0                                                                                                 | 9                                                                                   |
| 3500K               | 2.5                                      | 3.00 | -1.0 to -3.0                                                                                                 | 9                                                                                   |
| 4000K               | 2.5                                      | 3.00 | -1.0 to -3.0                                                                                                 | 9                                                                                   |
| 5000K               | 2.5                                      | 3.00 | -1.0 to -3.0                                                                                                 | 9                                                                                   |

Notes for Table 3:

1. Lumileds maintains a tolerance of  $\pm 0.06V$  on forward voltage measurements.
2. Measured between  $T_j = 25^\circ C$  and  $T_j = 110^\circ C$  at  $I_f = 350mA$ .

## Absolute Maximum Ratings

Table 4.

| Parameter                                  | Maximum Performance                                                  |
|--------------------------------------------|----------------------------------------------------------------------|
| DC Forward Current (mA) <sup>[2]</sup>     | 1000                                                                 |
| Peak Pulsed Forward Current <sup>[3]</sup> | 1000                                                                 |
| ESD Sensitivity                            | < 8000V Human Body Model (HBM) Class 3A JESD22-A114-E                |
| LED Junction Temperature <sup>[1]</sup>    | 150°C                                                                |
| Operating Case Temperature at 700mA        | -40°C - 135°C                                                        |
| Storage Temperature                        | -40°C - 135°C                                                        |
| Soldering Temperature                      | JEDEC 020c 260°C                                                     |
| Allowable Reflow Cycles                    | 3                                                                    |
| Reverse Voltage ( $V_r$ )                  | LUXEON Rebel PLUS LEDs are not designed to be driven in reverse bias |

Notes for Table 4:

1. Proper current derating must be observed to maintain junction temperature below the maximum. For additional information on thermal measurement guidelines please refer to Application Brief AB33.
2. Residual periodic variations due to power conversion from alternating current (AC) to direct current (DC), also called 'ripple', with frequencies  $\geq 100$  Hz and amplitude  $\leq 300mA$  are acceptable, assuming the average current throughout each cycle does not exceed 1000mA.
3. Pulsed operation with a peak drive current of 1000mA is acceptable if the pulse on-time is  $\leq 5$  ms per cycle and the duty cycle is  $\leq 50\%$ .

## JEDEC Moisture Sensitivity

Table 5.

| Level | Floor Life |                             | Soak Requirements      |               |
|-------|------------|-----------------------------|------------------------|---------------|
|       |            |                             | Standard               |               |
|       | Time       | Conditions                  | Time                   | Conditions    |
| 1     | Unlimited  | $\leq 30^\circ C / 85\% RH$ | 168 Hrs. + 5 / -0 Hrs. | 85°C / 85% RH |

# Reflow Soldering Characteristics

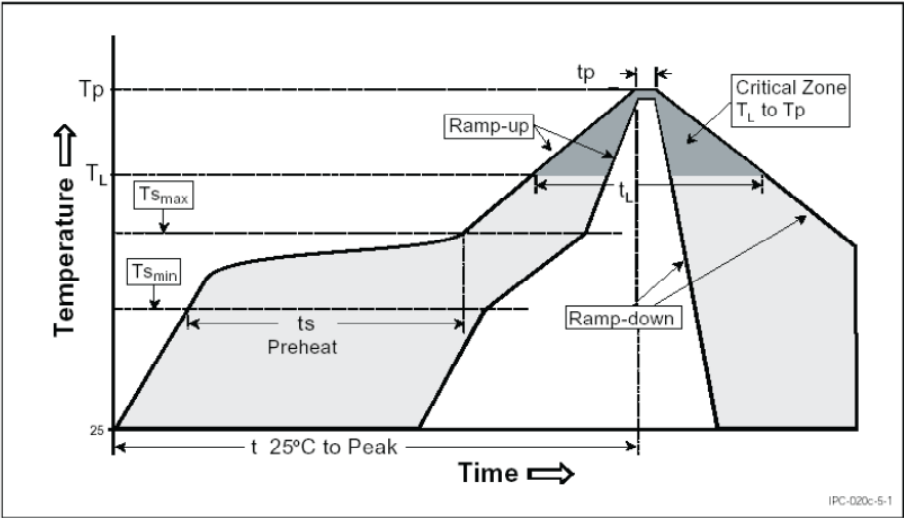


Figure 1. Temperature Profile for Table 6.

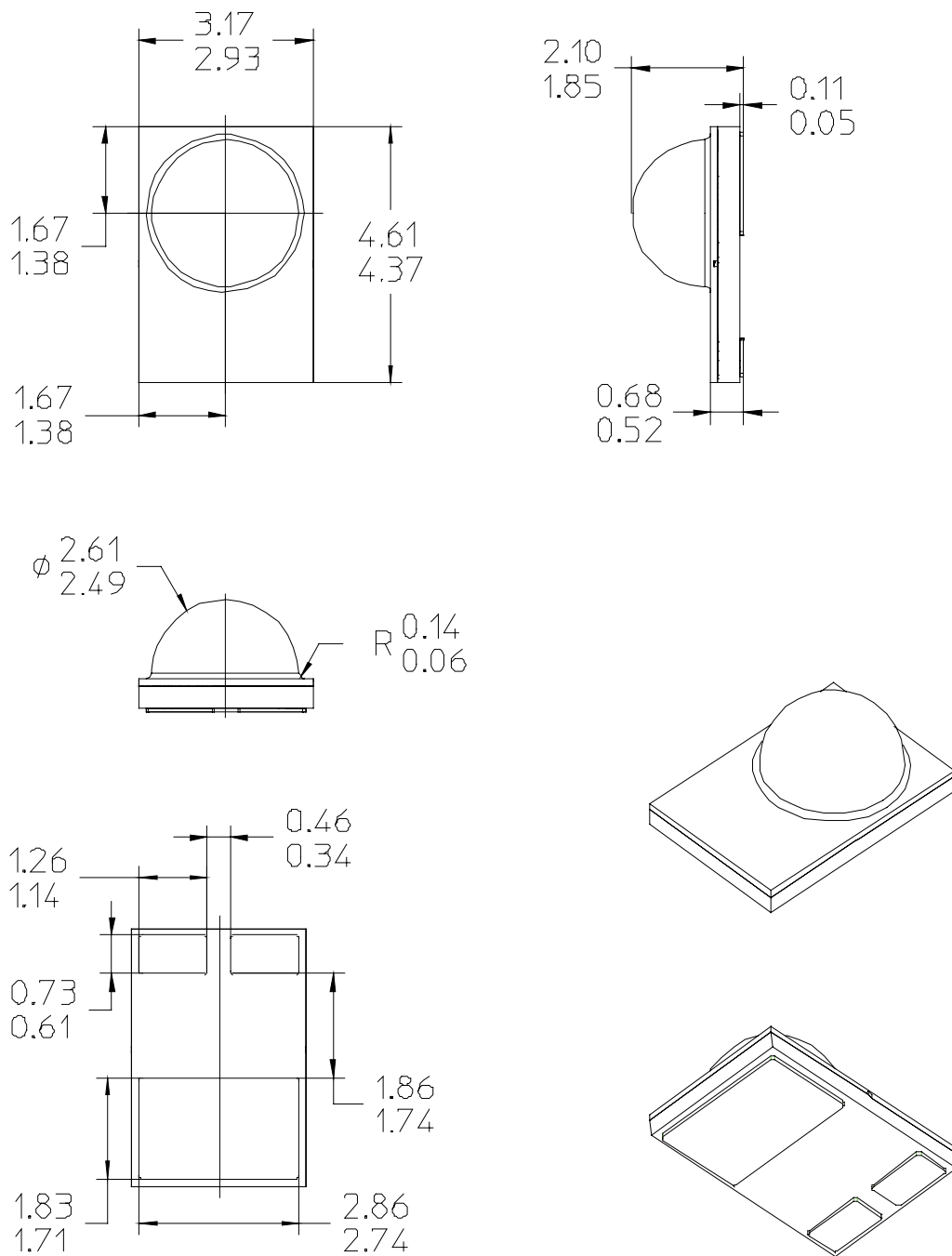
Table 6.

| Profile Feature                                      | Lead Free Assembly |
|------------------------------------------------------|--------------------|
| Average Ramp-Up Rate ( $T_{s_{max}}$ to $T_p$ )      | 3°C / second max   |
| Preheat Temperature Min ( $T_{s_{min}}$ )            | 150°C              |
| Preheat Temperature Max ( $T_{s_{max}}$ )            | 200°C              |
| Preheat Time ( $t_{s_{min}}$ to $t_{s_{max}}$ )      | 60 - 180 seconds   |
| Temperature ( $T_L$ )                                | 217°C              |
| Time Maintained Above Temperature $T_L$              | 60 - 150 seconds   |
| Peak / Classification Temperature ( $T_p$ )          | 260°C              |
| Time Within 5°C of Actual Peak Temperature ( $t_p$ ) | 20 - 40 seconds    |
| Ramp-Down Rate                                       | 6°C / second max   |
| Time 25°C to Peak Temperature                        | 8 minutes max      |

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 2. Package outline drawing.**

## Notes for Figure 2:

1. Do not handle the device by the lens, as the lens or the interior of the device can be damaged by excessive force to the lens.
2. Drawings not to scale. All dimensions are in millimeters.
3. The thermal pad is electrically isolated from the anode and cathode contact pads.

# Pad Configuration

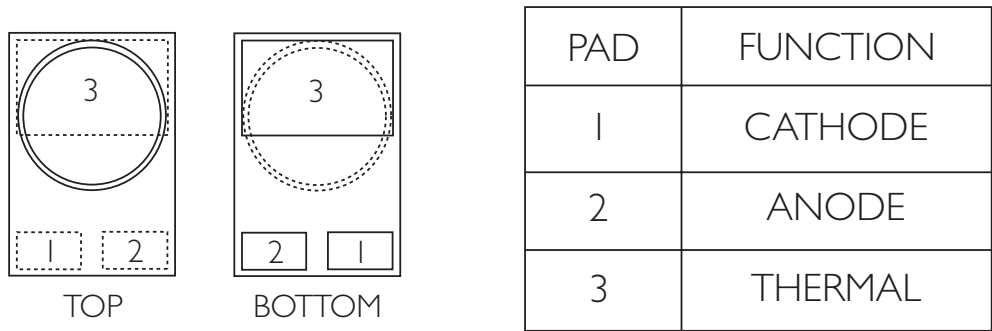


Figure 3. Pad configuration.

Note for Figure 3:

1. The Thermal Pad is electrically isolated from the Anode and Cathode contact pads.

# Solder Pad Design

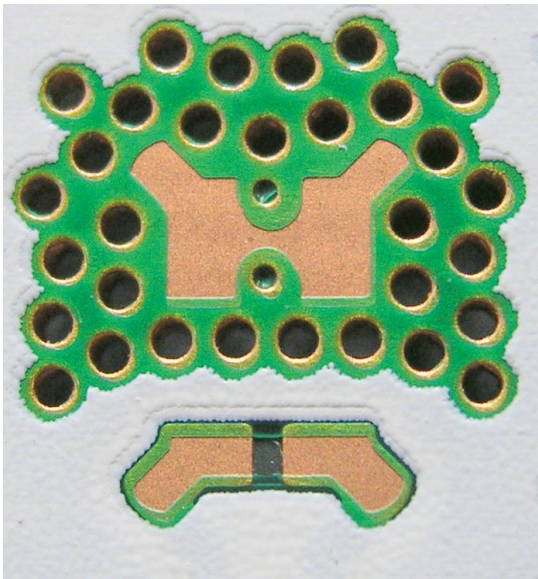


Figure 4. Solder pad layout.

Notes for Figure 4:

1. The photograph shows the recommended LUXEON Rebel PLUS layout on Printed Circuit Board (PCB). This design easily achieves a thermal resistance of 7K/W.

2. Application Brief AB32 provides extensive details for this layout. Printed Circuit Board layout files (.dwg) are available at [www.lumileds.com](http://www.lumileds.com).



# Typical Light Output Characteristics over Temperature

All LUXEON Rebel PLUS Emitters at Test Current, 350mA

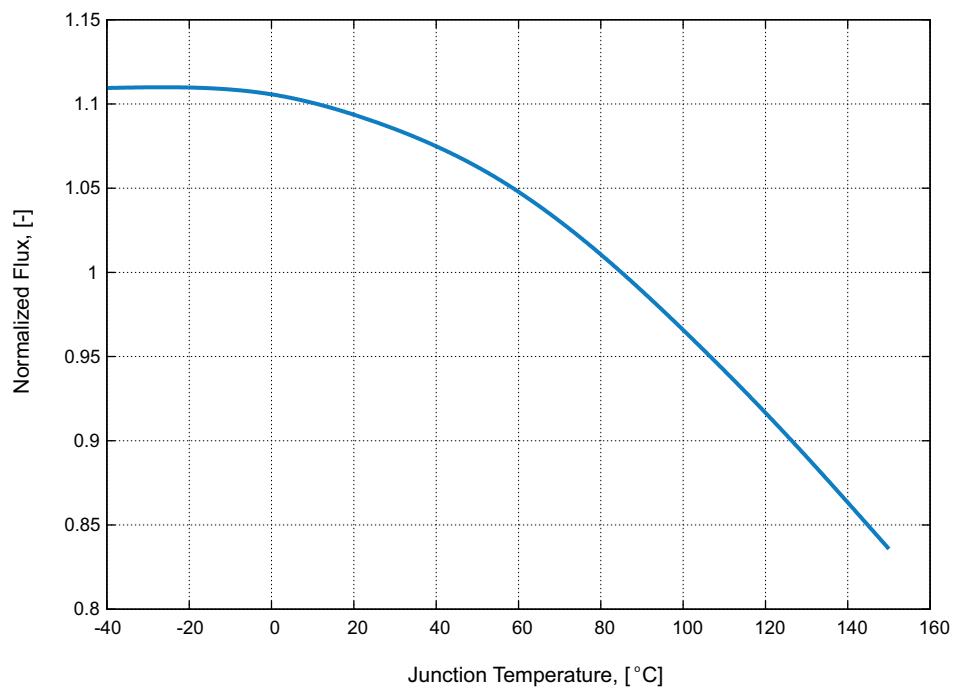


Figure 5. Relative light output vs. junction temperature.

# Typical Forward Current Characteristics

All LUXEON Rebel PLUS Emitters, Junction Temperature = 85°C

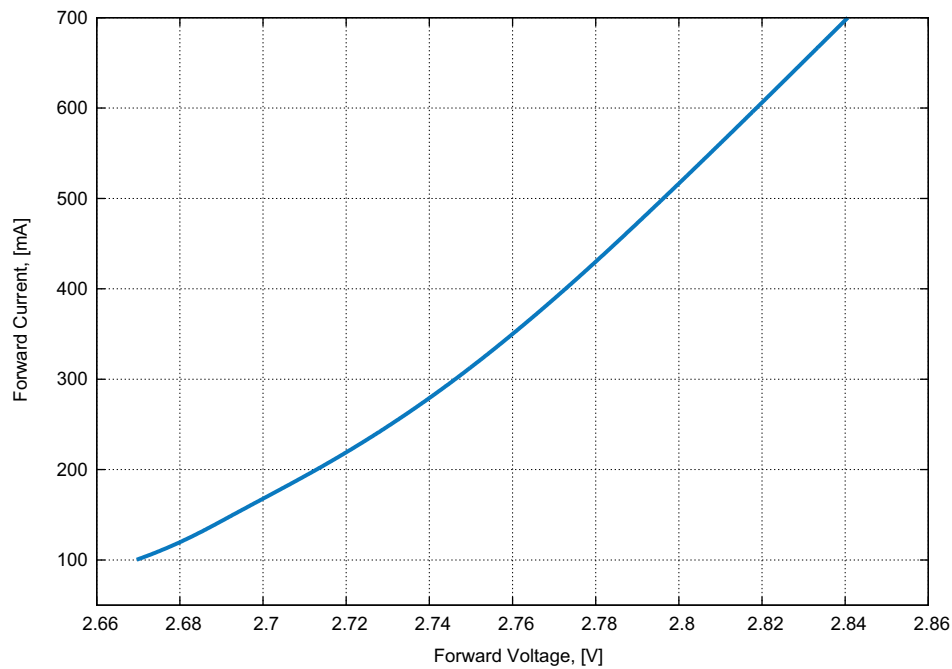


Figure 6. Forward current vs. forward voltage.

Typical Relative Luminous Flux vs. Forward Current for All LUXEON Rebel PLUS Emitters, Junction Temperature = 85°C

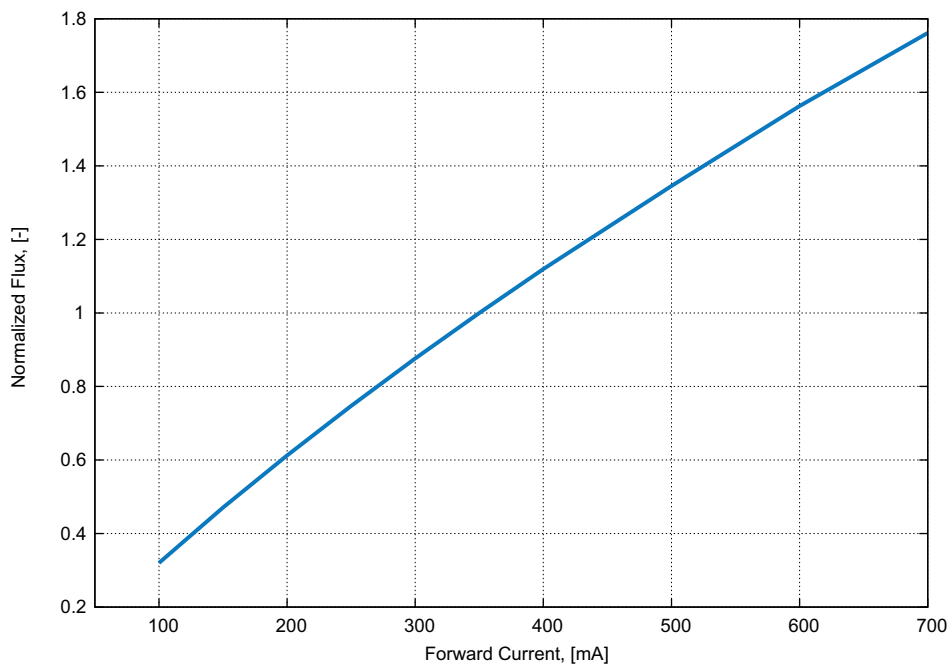


Figure 7. Typical relative luminous flux vs. forward current, junction temperature = 85°C.

# Typical Radiation Patterns

## Relative Spectral Distribution for LUXEON Rebel PLUS Emitters

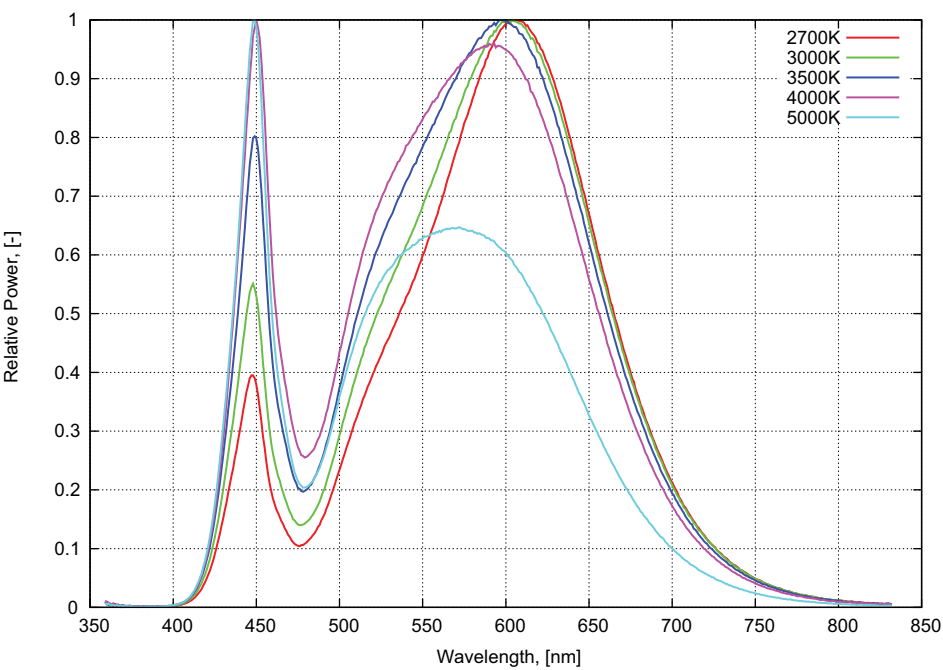


Figure 8. Cartesian plot of typical luminous intensity.

## Typical Polar Radiation Pattern

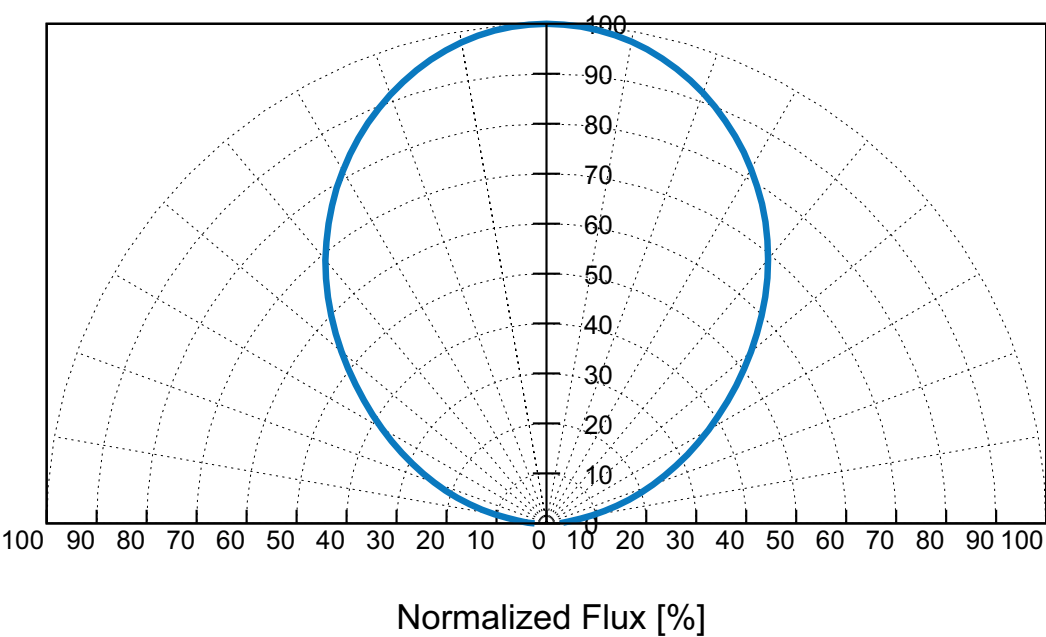


Figure 9. Typical polar radiation pattern.

# Emitter Pocket Tape Packaging

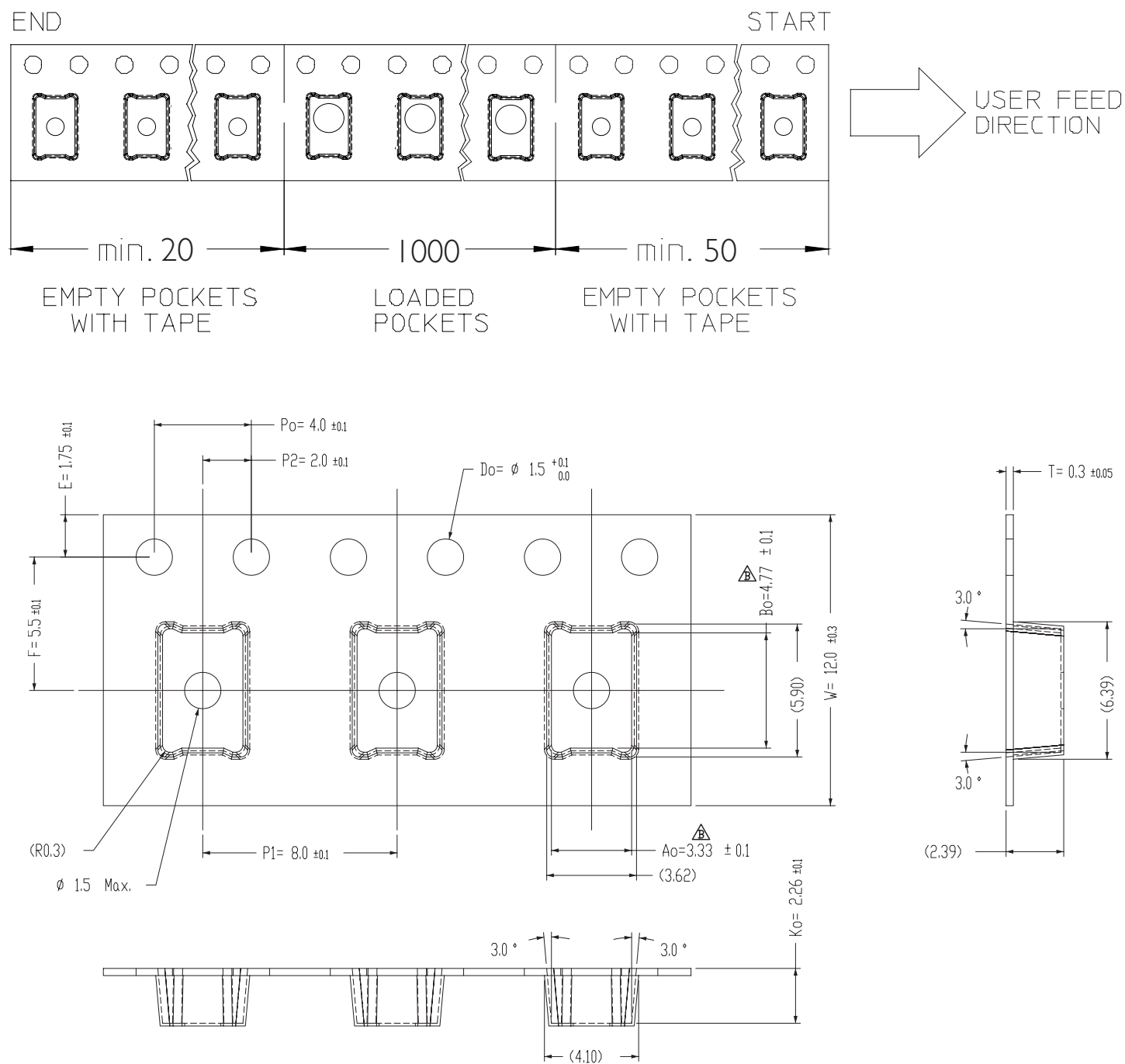


Figure 10. Emitter pocket tape packaging.

# Emitter Reel Packaging

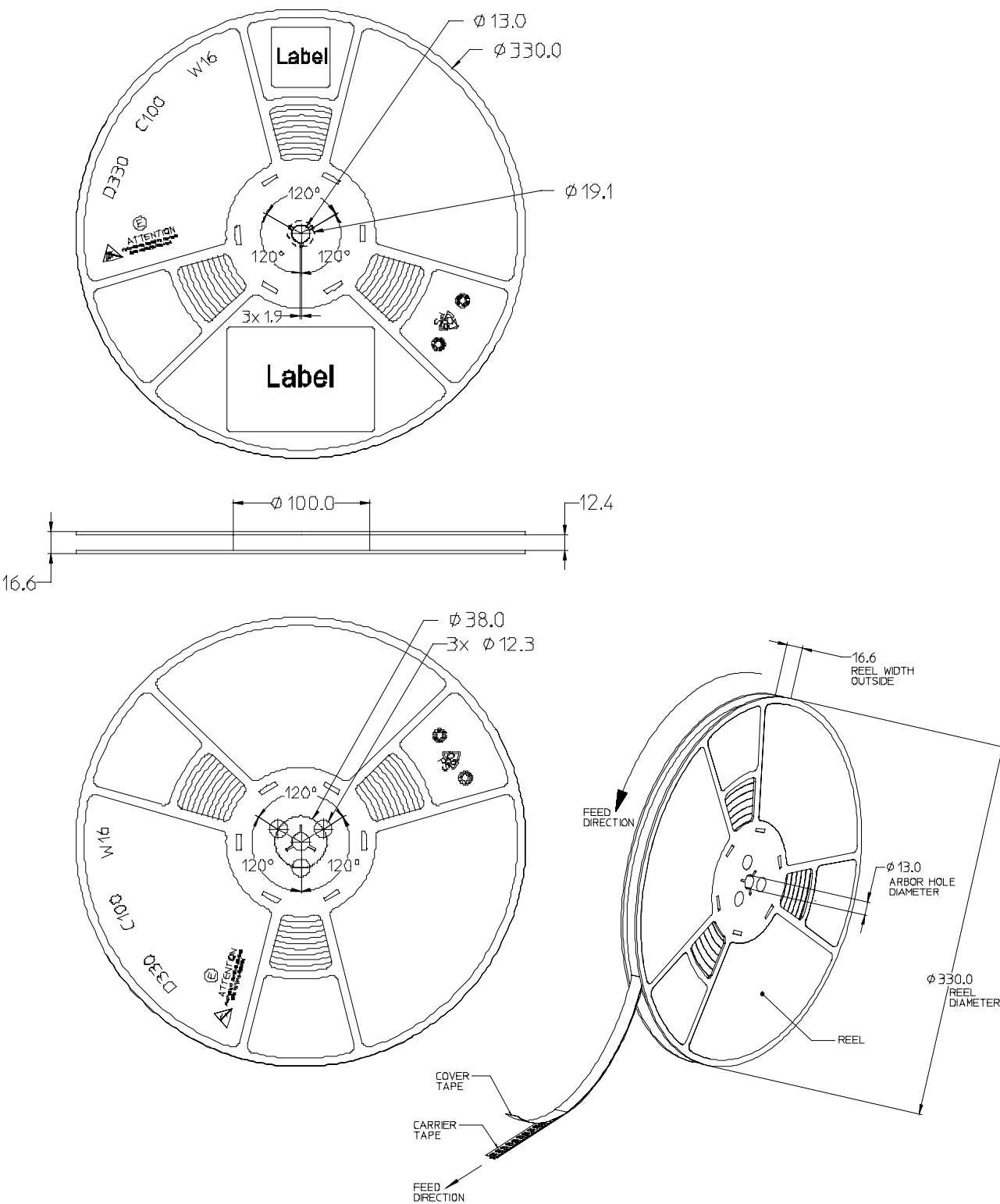


Figure 11. Emitter reel packaging.

# 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, Lumileds bins the LED components for luminous flux and forward voltage ( $V_f$ ). Color is offered in a single 3-step or 5-step MacAdam ellipse color space centered on the ANSI CCT color bins. For additional information please review the MacAdam ellipse technical definition section.

## Decoding Product Bin Labeling

LUXEON Rebel PLUS 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 LUXEON Rebel PLUS emitters are labeled with a three digit alphanumeric CAT code following the format below.

A B C D

A = Flux bins (A, B, C, D, E, F,G)

B and C = Color Bins (13, 1A, 1B, 1C, 1D)

D = Voltage Bins (1, 2)

| A                  |
|--------------------|
| Flux Bin           |
| see flux bin table |

| B   |            |
|-----|------------|
| CRI |            |
| 1   | 80 CRI min |

| C         |        |
|-----------|--------|
| Color Bin |        |
| 3         | 3-step |
| A         | 5-step |
| B         |        |
| C         |        |
| D         |        |

| D  |       |       |
|----|-------|-------|
| Vf | min   | max   |
| 1  | 2.50V | 2.75V |
| 2  | 2.75V | 3.00V |

# Luminous Flux and Forward Voltage Bins

Table 7 lists the standard photometric luminous flux bins for LUXEON Rebel PLUS emitters (tested and binned at 350mA D.C., Junction Temperature = 85°C. Minimum luminous flux performance within published operating conditions. Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux measurements.

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 CCT's.

**Table 7. Luminous Flux Bins**

| Bin Code         | Minimum Photometric Flux (lm) | Maximum Photometric Flux (lm) |
|------------------|-------------------------------|-------------------------------|
| A <sup>[2]</sup> | 75                            | 85                            |
| B                | 85                            | 95                            |
| C                | 95                            | 105                           |
| D                | 105                           | 115                           |
| E                | 115                           | 125                           |
| F                | 125                           | 135                           |

Notes for Table 7:

1. Minimum luminous flux performance within published operating conditions. Lumileds maintains a tolerance of  $\pm 6.5\%$  on luminous flux measurements.
2. For LX18-P127 minimum flux is 80 lm.
  - A is the cat code for 80-85 lm for the above emitters.
3. For LX18-P135 and LX18-P140 minimum flux is 90 lm.
  - B is the cat code for 90-95 lm for the above emitters.

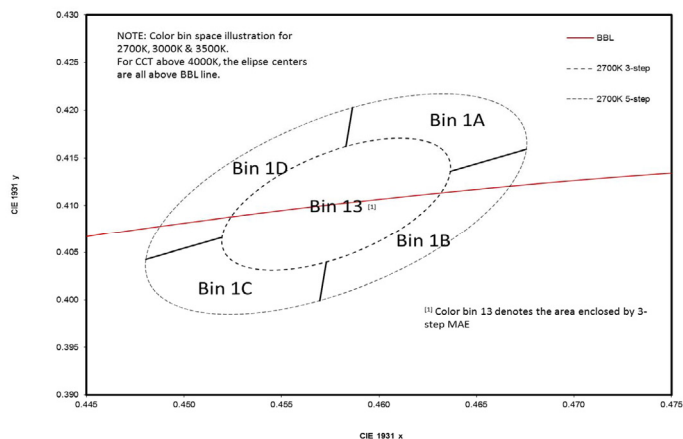
Table 8 lists minimum and maximum  $V_f$  bin values per emitter (tested and binned at 350mA). Although several bins are outlined, product availability in a particular bin varies by production run and by product performance.

**Table 8.  $V_f$  Bins**

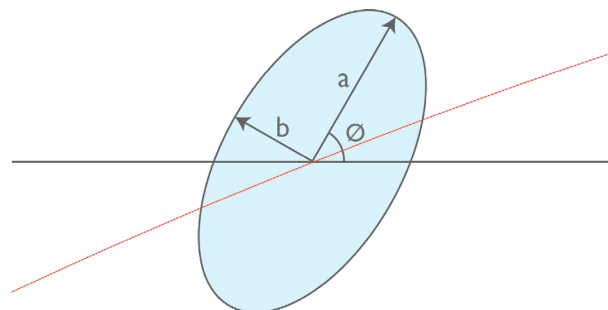
| Bin Code | Minimum Forward Voltage (V) | Maximum Forward Voltage (V) |
|----------|-----------------------------|-----------------------------|
| 1        | 2.50                        | 2.75                        |
| 2        | 2.75                        | 3.00                        |

# LUXEON Rebel PLUS 3-step and 5-step MacAdam Ellipse Color Definition

Tested at 350mA D.C. & Junction Temperature = 85°C



Color Space Definition for Above and Below Blackbody



Parameter Definition of MacAdam Ellipse

Table 9. LUXEON Rebel PLUS Product Characteristics for 3-step MacAdam Ellipse

| Part Number | Nominal ANSI CCT | Color Space                   | Center Point (cx, cy) | Major Axis, a | Minor Axis, b | Ellipse Rotation Angle (degrees) |
|-------------|------------------|-------------------------------|-----------------------|---------------|---------------|----------------------------------|
| LX18-P127-3 | 2700K            | Single 3-step MacAdam ellipse | (0.4578, 0.4101)      | 0.00810       | 0.00420       | 53.7                             |
| LX18-P130-3 | 3000K            | Single 3-step MacAdam ellipse | (0.4338, 0.4030)      | 0.00834       | 0.00408       | 53.2                             |
| LX18-P135-3 | 3500K            | Single 3-step MacAdam ellipse | (0.4073, 0.3917)      | 0.00927       | 0.00414       | 54.0                             |
| LX18-P140-3 | 4000K            | Single 3-step MacAdam ellipse | (0.3818, 0.3797)      | 0.00939       | 0.00402       | 53.7                             |
| LX18-P150-3 | 5000K            | Single 3-step MacAdam ellipse | (0.3447, 0.3553)      | 0.00822       | 0.00354       | 59.6                             |

Table 10. LUXEON Rebel PLUS Product Characteristics for 5-step MacAdam Ellipse

| Part Number | Nominal ANSI CCT | Color Space                   | Center Point (cx, cy) | Major Axis, a | Minor Axis, b | Ellipse Rotation Angle (degrees) |
|-------------|------------------|-------------------------------|-----------------------|---------------|---------------|----------------------------------|
| LX18-P127-5 | 2700K            | Single 5-step MacAdam ellipse | (0.4578, 0.4101)      | 0.01350       | 0.00700       | 53.7                             |
| LX18-P130-5 | 3000K            | Single 5-step MacAdam ellipse | (0.4338, 0.4030)      | 0.01390       | 0.00680       | 53.2                             |
| LX18-P135-5 | 3500K            | Single 5-step MacAdam ellipse | (0.4073, 0.3917)      | 0.01545       | 0.00690       | 54.0                             |
| LX18-P140-5 | 4000K            | Single 5-step MacAdam ellipse | (0.3818, 0.3797)      | 0.01565       | 0.00670       | 53.7                             |
| LX18-P150-5 | 5000K            | Single 5-step MacAdam ellipse | (0.3447, 0.3553)      | 0.01370       | 0.00590       | 59.6                             |

Notes for Tables 9 and 10:

1. Lumileds maintains a tester tolerance of  $\pm 0.005$  on x, y color coordinates.



# About Lumileds

Lumileds is the light engine leader, delivering innovation, quality, and reliability.

For 100 years, Lumileds commitment to innovation has helped customers pioneer breakthrough products in the automotive, consumer and illumination markets.

Lumileds is shaping the future of light with our LEDs and automotive lamps, and helping our customers illuminate how people see the world around them.

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



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