LUXEON FX Plus PC Amber

Industry-leading Chip Scale Package solutions for turn applications

LUXEON FX LEDs with their Chip Scale Package (CSP) form factor are designed to meet present and future Automotive requirements. The Lumileds automotive binning structure meets both SAE and ECE color specifications and is hot binned at 85°C, consistent with actual automotive operational environments. LUXEON FX Plus PC Amber provides industry-leading solutions for your front and rear turn applications. All LUXEON FX LEDs are IEC-60810 qualified.

<table>
<thead>
<tr>
<th>FEATURES AND BENEFITS</th>
<th>PRIMARY APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher drive current capability for increased flux performance</td>
<td>Side Marker</td>
</tr>
<tr>
<td>Low thermal resistance for better hot lumen performance</td>
<td>Turn</td>
</tr>
<tr>
<td>Chip Scale Packaging for low cost and ease of manufacturability</td>
<td>– Front Turn</td>
</tr>
<tr>
<td>Hot binned at 85°C mono pulse (MP) drive current to match closer to operating conditions</td>
<td>– Rear Turn</td>
</tr>
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General Product Information

Product Test Conditions
LUXEON FX Plus PC Amber LEDs are tested and binned using a 20ms monopulse (MP) at at 1000mA drive current, with a case temperature, $T_c$, of 85°C.

Part Number Nomenclature
Part numbers for LUXEON FX Plus PC Amber follow the convention below:

$$A \ 1 \ F \ X \ - \ B \ C \ D \ E \ F \ G \ H \ J \ K \ M \ N \ P \ Q$$

Where:

- $A$ - designates Automotive
- $1$ - designates level 1
- $F \ X$ - designates LUXEON FX product family
- $B \ C \ D \ E$ - designates wavelength (0591=PC Amber)
- $F$ - designates generation (A=Gen1)
- $G$ - designates test current (G=1000mA)
- $H$ - designates test temperature (H=85°C)
- $J$ - designates future product offerings
- $K \ M \ N \ P$ - designates minimum flux value (0170, 0180, 0190, 0200 and 0210)
- $Q$ - designates option code for distribution

Therefore, the following part number is used for a LUXEON FX Plus PC Amber with a minimum luminous flux of 190 lumens:

$$A \ 1 \ F \ X \ - \ 0 \ 5 \ 9 \ 1 \ A \ D \ H \ 0 \ 0 \ 1 \ 9 \ 0 \ 0$$
Environmental Compliance

Lumileds LLC is committed to providing environmentally friendly products to the solid-state lighting market. LUXEON FX 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 FX Plus PC Amber at 20ms MP, 1000mA, T_c=85°C.

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>MINIMUM LUMINOUS FLUX [1] (lm)</th>
<th>TEST CURRENT (mA)</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUXEON FX Plus PC Amber</td>
<td>170</td>
<td>1000</td>
<td>A1FX-0591ADH001700</td>
</tr>
<tr>
<td></td>
<td>180</td>
<td>1000</td>
<td>A1FX-0591ADH001800</td>
</tr>
<tr>
<td></td>
<td>190</td>
<td>1000</td>
<td>A1FX-0591ADH001900</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>1000</td>
<td>A1FX-0591ADH002000</td>
</tr>
<tr>
<td></td>
<td>210</td>
<td>1000</td>
<td>A1FX-0591ADH002100</td>
</tr>
</tbody>
</table>

Notes for Table 1:
1. Lumileds maintains a tolerance of ±6.5% on luminous flux measurements.

Optical Characteristics

Table 2. Typical optical characteristics for LUXEON FX Plus PC Amber at 20ms MP, 1000mA, T_c=85°C.

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DOMINANT WAVELENGTH (nm)</th>
<th>SPECTRAL HALF-WIDTH (nm) Δλ 1/2</th>
<th>TOTAL INCLUDED ANGLE θ_{0.80V}</th>
<th>TYPICAL VIEWING ANGLE 2θ 1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1FX-0591ADHxxxxxxxx</td>
<td>588.8</td>
<td>77</td>
<td>140°</td>
<td>117°</td>
</tr>
</tbody>
</table>

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.
Electrical and Thermal Characteristics

Table 3. Typical electrical and thermal characteristics for LUXEON FX Plus PC Amber at MP, 1000mA, T_c=85°C.

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>FORWARD VOLTAGE[^1] (V_f)</th>
<th>THERMAL RESISTANCE—JUNCTION TO CASE (°C/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
</tr>
<tr>
<td>A1FX-0591ADHxxxxxx</td>
<td>2.55</td>
<td>3.51</td>
</tr>
</tbody>
</table>

Notes for Table 3:
1. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
2. \( \theta_{j-c \text{ el}} \): Electrical thermal resistance (junction to case).
3. \( \theta_{j-c \text{ real}} \): Real thermal resistance (junction to case) with wall plug efficiency included. Reference JESD51-51, JESD51-14, 4.1.3.
4. Calculated (5s).

Absolute Ratings

Table 4. Absolute ratings for LUXEON FX Plus PC Amber.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum DC Forward Current</td>
<td>50mA</td>
</tr>
<tr>
<td>Maximum DC Forward Current</td>
<td>1000mA</td>
</tr>
<tr>
<td>Maximum Junction Temperature[^1]</td>
<td>150°C</td>
</tr>
<tr>
<td>Operating Case Temperature at Test Current</td>
<td>-40°C to 125°C</td>
</tr>
<tr>
<td>Operating Case Temperature at Maximum Current</td>
<td>-40°C to 125°C</td>
</tr>
<tr>
<td>Maximum Junction Temperature for &lt;200 Hours (1000mA)[^1]</td>
<td>180°C</td>
</tr>
<tr>
<td>LED Storage Temperature</td>
<td>-40°C to 130°C</td>
</tr>
<tr>
<td>Soldering Temperature</td>
<td>260°C</td>
</tr>
<tr>
<td>Allowable Reflow Cycles</td>
<td>3</td>
</tr>
<tr>
<td>ESD Sensitivity[^2]</td>
<td>±8 kV HBM, ±400 V MM, ±2kV CDM</td>
</tr>
<tr>
<td>Reverse Voltage (V_{reverse})</td>
<td>LUXEON FX LEDs are not designed to be driven in reverse bias</td>
</tr>
<tr>
<td>Autoclave Conditions</td>
<td>121°C at 2 ATM 100% Relative Humidity for 96 Hours Maximum</td>
</tr>
</tbody>
</table>

Notes for Table 4:
1. Given for reference only, LUXEON FX LEDs driven above maximum LED case temperature and/or maximum if may have shorter lifetime.
2. Measured using human body model (per JESD22 A114), machine model (per JESD22 A115) and charged device model (per JESD22 C101).

JEDEC Moisture Sensitivity

Table 5. Moisture sensitivity levels for LUXEON FX Plus PC Amber.

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>FLOOR LIFE</th>
<th>STANDARD SOAK REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TIME</td>
<td>CONDITIONS</td>
</tr>
<tr>
<td>1</td>
<td>Unlimited</td>
<td>≤30°C / 85% RH</td>
</tr>
</tbody>
</table>
Characteristic Curves

Spectral Power Distribution Characteristics

Figure 1a. Typical normalized power vs. wavelength for LUXEON FX Plus PC Amber at 20ms MP, 1000mA, T_c=85°C.

Figure 1b. Typical dominant wavelength shift vs. case temperature for LUXEON FX Plus PC Amber at 20ms MP, 1000mA.
Light Output Characteristics

Figure 2a. Typical normalized light output vs. case temperature for LUXEON FX Plus PC Amber at 20ms MP, 1000mA.

Figure 2b. Typical normalized light output vs. forward current for LUXEON FX Plus PC Amber at $T_c=85^\circ C$. 
Forward Current Characteristics

Figure 3a. Typical forward current vs. forward voltage for LUXEON FX Plus PC Amber, LUXEON FX Plus PC Amber at 20ms MP, 1000mA.

Figure 3b. Typical forward voltage shift vs. case temperature for LUXEON FX Plus PC Amber at 20ms MP, 1000mA.
Color Shift Characteristics

Figure 4a. Typical color shift in CIE 1931 x and y coordinates over temperature for LUXEON FX Plus PC Amber at 20ms MP, 1000mA.

Figure 4b. Typical color shift in CIE 1931 x and y coordinates over current for LUXEON FX Plus PC Amber at 20ms MP, 85°C.
Figure 4c. Typical color shift in CIE 1931 x and y coordinates over angle for LUXEON FX Plus PC Amber at 20ms MP, 1000mA.
Radiation Pattern Characteristics

Figure 5. Typical Radiation Pattern for LUXEON FX Plus PC Amber at 20ms MP, 1000mA.

Operating Limits Characteristics

Figure 6. Maximum forward current vs. case temperature for LUXEON FX Plus PC-Amber.
Permissible Pulse Handling Characteristics

Figure 7. Permissible pulse handling capability for LUXEON FX Plus PC Amber.
Product Bin and Labeling Definitions

Designing with LUXEON FX Plus PC Amber

Flux bins supportable for car programs depend on product color and program start- and end-of-production date. Flux roadmaps by year and product color are maintained and available from the sales representative. Please contact your local sales representative to request the flux bin range with best supportability for program timing.

Decoding Product Bin Labeling

In the manufacturing of semiconductor products, there are variations in performance around the average values given in the technical datasheets. For this reason, Lumileds bins the LED components for luminous flux, color and forward voltage.

LUXEON FX Plus PC Amber are labeled using a 3-digit alphanumeric CAT code following the format below.

A  B  C

Where:

A  -  designates luminous flux bin (example: B=170 lumens to 180 lumens)
B  -  designates color code (example: A or B)
C  -  designates forward voltage bin (example: B=2.55V to 2.79V)

Therefore, a LUXEON FX Plus PC Amber with a lumen range of 190 to 200, color bin of A and a forward voltage range of 2.55 to 2.79 has the following CAT code:

D  A  B

Luminous Flux Bins

Table 6 lists the standard luminous flux bins for LUXEON FX Plus PC Amber emitters. Product availability in a particular bin varies by color and platform start-of-production date. Contact your local sales representative for best supportability of programs.

<table>
<thead>
<tr>
<th>BIN</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>170</td>
<td>180</td>
</tr>
<tr>
<td>C</td>
<td>180</td>
<td>190</td>
</tr>
<tr>
<td>D</td>
<td>190</td>
<td>200</td>
</tr>
<tr>
<td>E</td>
<td>200</td>
<td>210</td>
</tr>
<tr>
<td>F</td>
<td>210</td>
<td>220</td>
</tr>
</tbody>
</table>

Notes for Table 6:
1. Lumileds maintains a tolerance of ±6.5 on luminous flux measurements.
Color Codes

![Color bin structure in CIE 1931 color space for LUXEON FX Plus PC Amber.](image)

Table 7. Color code definitions for LUXEON FX Plus PC Amber at 20ms MP, 1000mA.

<table>
<thead>
<tr>
<th>CODE</th>
<th>(x^{(1)})</th>
<th>(y^{(2)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.5680</td>
<td>0.4315</td>
</tr>
<tr>
<td></td>
<td>0.5634</td>
<td>0.4269</td>
</tr>
<tr>
<td></td>
<td>0.5833</td>
<td>0.4075</td>
</tr>
<tr>
<td></td>
<td>0.5901</td>
<td>0.4094</td>
</tr>
<tr>
<td>B</td>
<td>0.5763</td>
<td>0.4054</td>
</tr>
<tr>
<td></td>
<td>0.5833</td>
<td>0.4075</td>
</tr>
<tr>
<td></td>
<td>0.5634</td>
<td>0.4269</td>
</tr>
<tr>
<td></td>
<td>0.5557</td>
<td>0.4192</td>
</tr>
</tbody>
</table>

Notes for Table 7:
1. Lumileds maintains a tolerance of ±0.005 on x and y coordinates in the CIE 1931 color space.

Forward Voltage Bins

Table 8. Forward voltage bin definitions for LUXEON FX Plus PC Amber.

<table>
<thead>
<tr>
<th>BIN (^{(1)})</th>
<th>FORWARD VOLTAGE ((V_f)^{(2)})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MINIMUM</td>
</tr>
<tr>
<td>B</td>
<td>2.55</td>
</tr>
<tr>
<td>C</td>
<td>2.79</td>
</tr>
<tr>
<td>D</td>
<td>3.03</td>
</tr>
<tr>
<td>E</td>
<td>3.27</td>
</tr>
</tbody>
</table>

Notes for Table 8:
1. Although several bins are outlined, product availability in a particular bin varies by production run and by product performance.
2. Lumileds maintains a tolerance of ±0.06V on forward voltage measurements.
Mechanical Dimensions

Figure 9. Mechanical dimensions for LUXEON FX Plus PC Amber.

Notes for Figure 9:
1. Drawings are not to scale.
2. All dimensions are in millimeters.
Packaging Information

Pocket Tape Dimensions

Cross section view A-A and B-B in this drawing are not drawn to scale in order to depict the details clearly.

![Pocket Tape Dimensions Diagram]

Figure 10. Emitter pocket tape dimensions for LUXEON FX Plus PC Amber.

Reel Dimensions

![Reel Dimensions Diagram]

Figure 11. Reel dimensions for LUXEON FX Plus PC Amber.

Notes for Figures 10 and 11:
1. All dimensions are in millimeters.
2. $A_0$ is the width of pocket, $K_0$ is the depth of pocket, $B_0$ is the height of pocket.
3. SPI is the number of LEDs per reel.
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.