# FLP "Flat-top" Series Lenses for LUXEON™ K2 LEDs

- **High efficiency**
- **Available in 4 different beams and 2 different lens holders**

The FLP series offers 4 lenses specifically designed for the Lumileds (1) LUXEON® K2 LEDs.

A software-optimized aspheric profile combined with a shaped front surfaces and Fresnel profiles, provide 4 different output patterns: narrow, medium, wide, and elliptical.  The high collection efficiency reaches 85% of the total flux emitted from the LED.

Each of these 4 lenses can be used alone on the LUXEON® K2 LEDs, or with the Fraen lens holder.  The lens holder assures the proper relative placement of the lens on the LED.  Screws, adhesive, or heat-staking the 3 legs of the holder to the customer's PCB or heat sink provides an excellent optical and mechanical assembly (see Fraen Application Note for heat-staking FAN01-EN, at www.fraensrl.com ).

Typical applications are:

- General illumination
- Architectural Lighting
- Flashlights
- Most applications where a compact light source is required.

(1) LUXEON® K2 is a trademark of Lumileds Lighting, LLC. For technical specification on LEDs please refer to the LUXEON® K2 datasheet or visit http://www.luxeon.com/ or Luxeon K2

(2) Typical beam divergence may change with different color LEDs.

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## General Characteristics

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|---|---|
| Lens Material | Optical Grade PMMA |
| Holder Material | PC/ABS |
| Operating Temperature range | -40deg C / + 95 deg C |
| Storage Temperature range | -40deg C / + 95 deg C |

Average transmittance in visible spectrum (400 – 700nm) >90%, as measured using 3mm thick Optical Grade PMMA.

*Please note that flow lines and weld lines on the external surfaces of the lenses are acceptable if the optical performance of the lens is within the specification described in the section "OPTICAL CHARACTERISTICS"*

**IMPORTANT NOTE – Lenses handling and cleaning**:
- *Handling: Always use gloves to handle lenses and/or handle the lenses only by the flange. Never touch the outside surfaces of the lenses with fingers; finger oils and contamination will absorb or refract light.*
- *Cleaning: Clean lenses only if necessary. Use only soap and water to clean the surfaces and lenses. Never expose the lenses to alcohol, as it will damage the plastic.*

## Optical Characteristics:

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| | | **Typical total beam divergence, FWHM (degrees)** (3) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Luxeon **K2** LEDs | | | | Luxeon **I** and **III** Lambertian | | |
| Lens Part Number | Beam Shape | Red, Orange, Amber | Green Cyan, Blue | Cool White | Warm White | Red, Orange, Amber | Green Cyan, Blue | Cool White |
| FLP-N4-LLK2-0R | Narrow | 12 | 12 | 11 | 11 | See note (4) | See note (4) | See note (4) |
| FLP-M4-LLK2-0R | Medium | 22 | 23 | 20 | 24 | See note (5) | See note (5) | See note (5) |
| FLP-W4-LLK2-0R | Wide | 42 | 45 | 44 | 44 | 38 | 38 | 38 |
| FLP-E4-LLK2-0R | Elliptical | 13x48 | 14x50 | 13x50 | 13x48 | 10x44(I) 14x44(III) | 11x44 | 12x45 |

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| | | Typical on-axis efficiency (candela/lumen) (6)(7) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Luxeon **K2** LEDs | | | | | Luxeon **I / III** Lambertian | | | |
| Lens Part Number | Beam Shape | Red, Orange, Amber 🔴🟠🟡 | Green Cyan 🟢🔵 | Blue 🔵 | Cool White ⚪ | Warm White 🟡 | Red, Orange, Amber 🔴🟠🟡 | Green Cyan 🟢🔵 | Blue 🔵 | Cool White ⚪ |
| FLP-N4-LLK2-0R | Narrow | 24.8 | 24.0 | * | 15 | 15 | See note (4) | See note (4) | See note (4) | See note (4) |
| FLP-M4-LLK2-0R | Medium | 5.8 | 6.8 | * | 3.9 | 4.0 | See note (5) | See note (5) | See note (5) | See note (5) |
| FLP-W4-LLK2-0R | Wide | 2.3 | 2.7 | * | 1.8 | 1.8 | 2.1 (I) 2.2 (III) | 2.8 (I) 3.2 (III) | 1.9 (I) 2.3 (III) | 2.0 (I) 2.6 (III) |
| FLP-E4-LLK2-0R | Elliptical | 6.1 | 6.5 | * | 4.1 | 4.1 | 7.2 (I) 3.4 (III) | 8.0 (I) 5.8 (III) | 6.1 (I) 4.8 (III) | 7.0 (I) 6.0 (III) |

\* These values have not been measured.

(3) The typical divergence varies with LED color due to different chip size and chip position tolerance.  The typical total divergence is the full angle measured where the luminous intensity is half of the peak value.
(4) For Narrow beam when using Luxeon I Lambertian LED or Luxeon III Lambertian LED, use Fraen part number FLP-HNB3-LL01-0. http://www.fraensrl.com/images/FLP_Lens_Series_Datasheet.pdf
(5) For Medium beam when using Luxeon I Lambertian LED or Luxeon III Lambertian LED, use Fraen part number FLP-HMB3-LL01-0. http://www.fraensrl.com/images/FLP_Lens_Series_Datasheet.pdf
(6) To calculate the on-axis intensity, multiply the on-axis efficiency of the lens (cd/lm) by the total flux of the Luxeon LED used.  See "Illumination Calculations" below.  For more detail on flux binning please check the Luxeon LED datasheet at http://www.luxeon.com/
(7) Luminous intensity depends on the flux binning and tolerances of the LEDs. Please refer to the Luxeon datasheet for more details on flux binning and mechanical tolerances.
(8) Typical illuminance measured in lux per lumen (E) with typical Luxeon™ LEDs.  To estimate the illuminance in lux, multiply the typical illuminance E by the flux in lumen of the LED used.  See "Illumination Calculations" below.

# Illumination Calculations
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To calculate peak candela: Select a lens and LED from the "Typical on-axis efficiency" table above. Find the corresponding "candela/lumen" value.  Multiply that value by the lumens output from your LED (refer to the K2 LED datasheet http://www.luxeon.com/pdfs/DS51.pdf for nominal lumens values).
Example - Fraen medium beam lens # FLP-M4-LLK2-0R on cool white K2 LED # LXK2-PW14T00: The table above indicates this lens produces 21 candela/lumen with a cool white K2 LED.  The LED datasheet indicates 80 lumens minimum and 85 lumens typical at 1000mA current.  Choosing 85 lumens, the calculation is: (21 candela/lumen) x (85 lumens) = 1785 candela peak on-axis.

The beam angle specified in the "Typical total beam divergence" table above indicates 24 degrees full beam-width measured at half-peak. This means at 12 degrees off-axis (half of 24 degrees), the intensity should be half of 1785 candela, or 892 candelas.
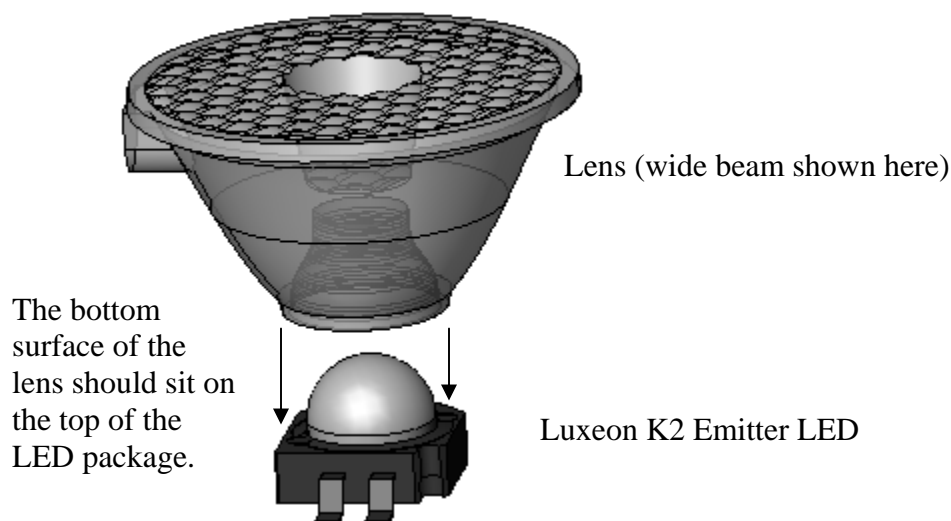
1 candela at 1-meter distance produces 1 Lux. This means the peak intensity at 1 meter will be 1785 lux. The intensity decreases as a function of the distance squared, so at 2 meters the peak intensity will be $1785 / (2^2) = 446$ lux. At 3 meters distance, the peak intensity will be $1785 / (3^2) = 198$ lux.
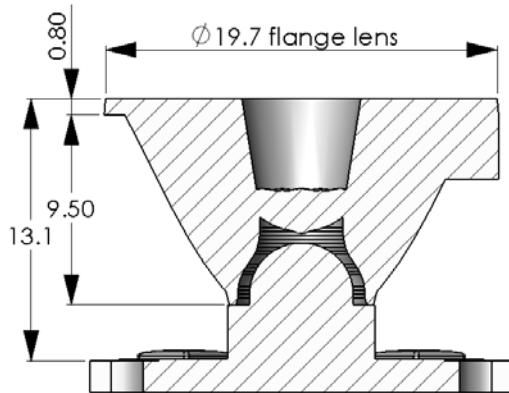
## Mechanical Characteristics

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The FLP Flat-top series of lenses has been designed specifically for the Luxeon Lambertian K2 LEDs. The FLP lenses can be used either **alone** or **with holder**.

One lens holder version provides 3 mounting legs for heat staking the lens assembly to a printed circuit board or heat sink. The other lens holder version provides a surface for adhesive and screw holes for self-threading screws or rivets. Either holder also helps to center the lens to the LED. To order a lens assembly (with holder), please see the "Ordering Part Numbers" section at the end of this datasheet.

**View and dimensions of lens on K2 LED (lens shown without lens holder):**



Lens (wide beam shown here)

The bottom surface of the lens should sit on the top of the LED package.

Luxeon K2 Emitter LED

Lens dimensions shown on next page…

Dimensions of lens on K2 LED (lens shown without lens holder):

Dimensions tolerance is +/-0.2mm

## **View and dimensions of lens + holder assembly (-HRL option, lens holder with legs) on K2 LED:**
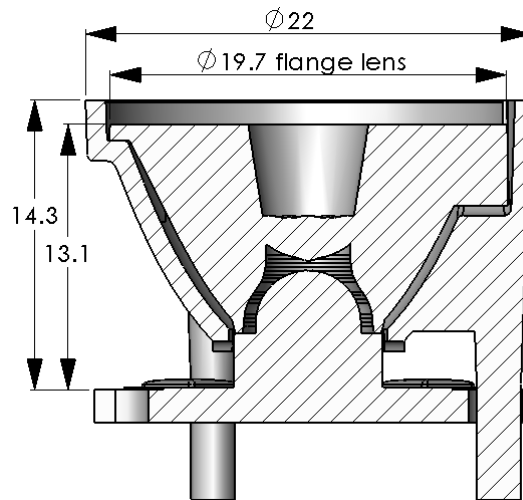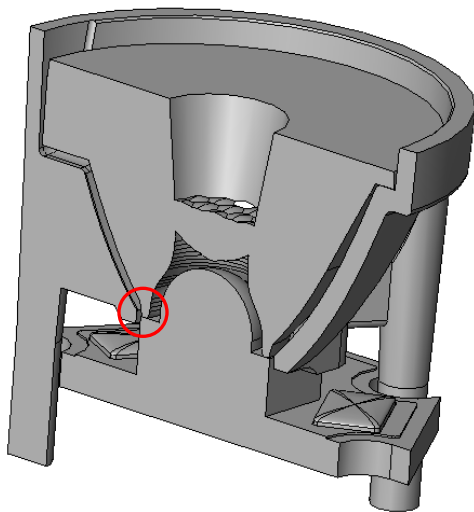


Dimensions tolerance is +/-0.2mm

X-section views:
FLP flat-top narrow-beam lens assembly (with 3-leg holder) on LUXEON K2 LED.
Notice that the bottom of the lens touches the top of the K2 LED package (shown on star-shaped PCB). The square shape on the bottom of the holder aligns the holder (and lens) to the square LED package.

Lens is assembled into lens holder and heat-staked by Fraen.

LUXEON K2 LED on star shaped PCB

Lens assembly is placed onto LUXEON K2 LED. Bottom of lens touches top of K2 package.

Three thru-holes are required for mounting leg clearance if using the 3-leg lens holder. This example shows the size and locations, on a 24mm diameter heat-sink (as example).



Dimensions tolerance is +/-0.2mm
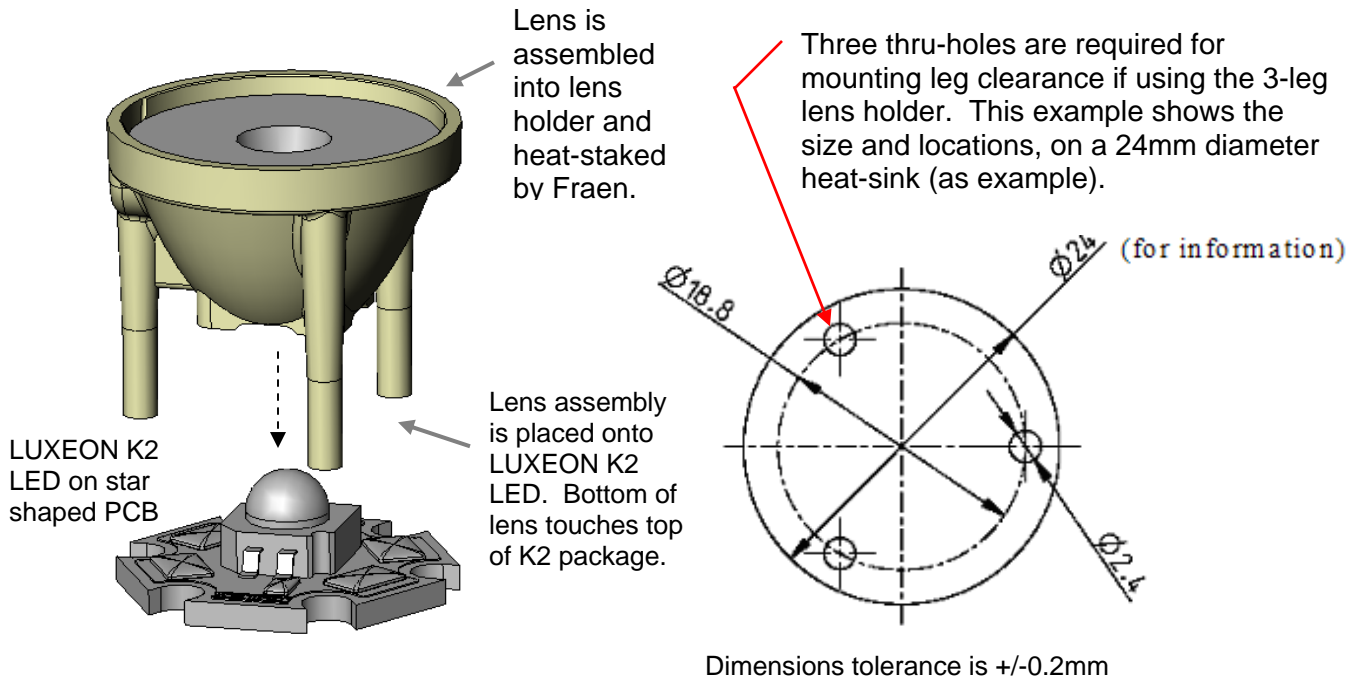
## View and dimensions of lens + holder assembly (-HRF option, lens holder flat on bottom, no legs) on K2 LED:
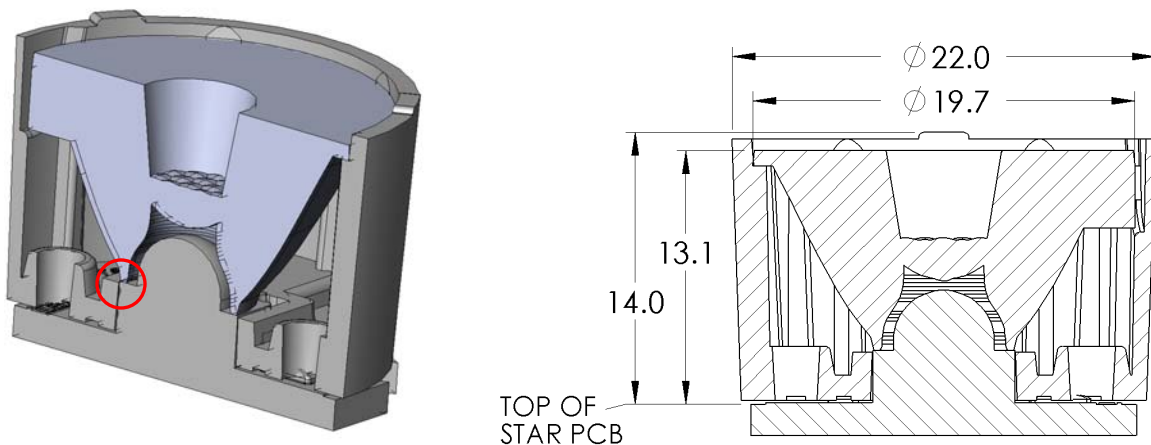


X-section views:
FLP flat-top narrow-beam lens assembly (with flat-bottom holder) on LUXEON K2 LED. Notice that the bottom of the lens touches the top of the K2 LED package (shown on star-shaped PCB). The square shape on the bottom of the holder aligns the holder (and lens) to the square LED package.
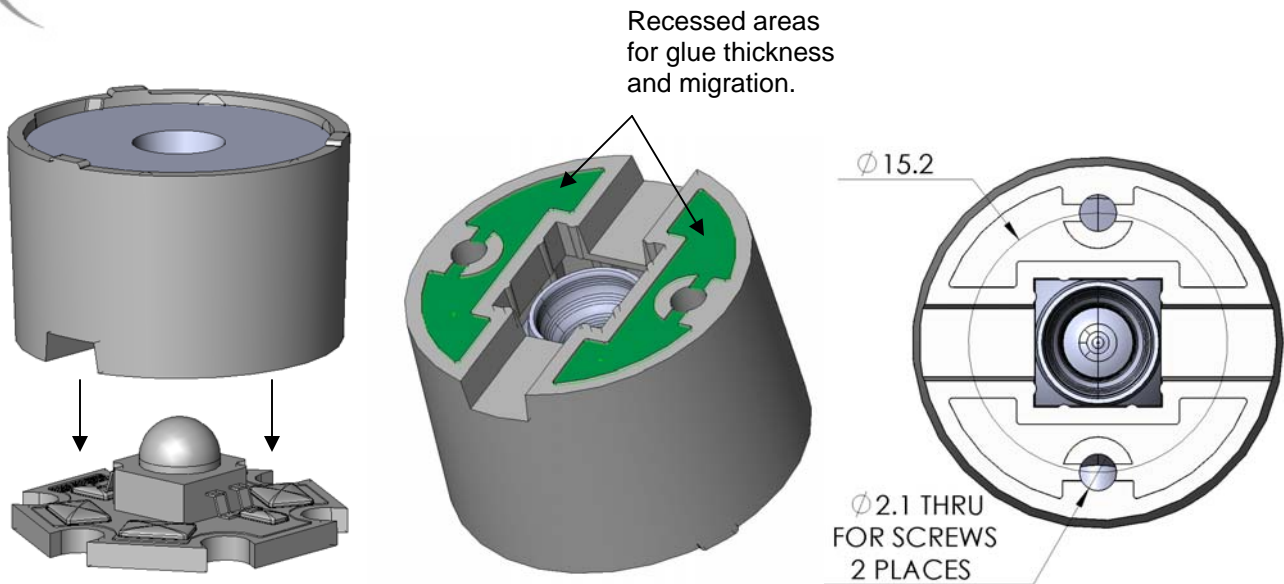
Recessed areas for glue thickness and migration.

⌀15.2

⌀2.1 THRU
FOR SCREWS
2 PLACES

The lens assembly can be secured to the PC board by using glue or silicone RTV.   To avoid glue on the lens and LED, apply it along the outside diameter edge, or apply a very thin film on areas shown above in green.  Alternatively, screws can be used for example ISO1481-ST2.9 metric.

CAUTION: Do not use "instant" glue (containing cyanoacrylates).  Always test the glue on a sample assembly and check the results and performance 24 hours later.  Some adhesives produce fumes that will damage the surfaces of the plastic lens, lens holder, or LED.

## Identifying the lenses by their front views:

The outside mechanical dimensions of the lenses (Narrow, Medium, Wide, and Elliptical beam lenses) are the same, except the front of the lens.  The lens can be recognized by their unique front views:

Front views of lenses:

| Narrow | Medium | Wide | Elliptical |
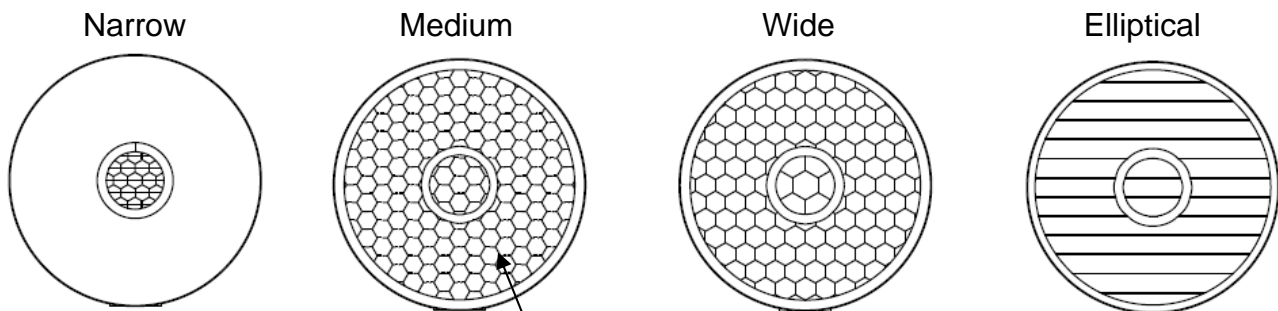


The medium beam lens has a light texture on the micro-lenses.

# FRAEN
MAXIMIZING LIGHT

## Ordering part numbers

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**For <u>lens only</u> (no holder)**

FLP-_4-LLK2-0R

**<u>Lens Type:</u>**

**N** = Narrow beam lens
**M** = Medium beam lens
**N** = Wide beam lens
**E** = Elliptical beam lens

**For <u>assembly</u> (lens + holder)**

FLP-_4-__-HR_

**<u>Holder Type:</u>**

**L** = Legs on holder, for heat staking to PCB.
**F** = Flat, no legs on holder.  Can be glued or screwed to PCB.

**<u>LED Type:</u>**

**LL** = Luxeon Lambertian I / III
**K2** = Luxeon K2

**<u>Lens Type:</u>**

**N** = Narrow beam lens
**M** = Medium beam lens
**W** = Wide beam lens
**E** = Elliptical beam lens

<u>Examples:</u>
FLP-N4-LLK2-0R   Lens, narrow beam, for Luxeon I, III, or K2 LED, no holder, round flange.
FLP-N4-K2-HRL    Lens, narrow beam, for Luxeon K2 LED, assembled to a round holder with legs
                  for heat staking to a PC board.
FLP-W4-LL-HRF    Lens, wide beam, for Luxeon Lambertian I / III LED, assembled to a round holder
                  with flat bottom (no legs) for screws or gluing to a PC board.

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Document Revision Record

| Rev | Date | Author | Description |
|-----|------|--------|-------------|
| 01 | 09 Sept 2008 | C. Jones | Added –HRF holder option. |
| 00 | 18 July 2007 | C. Jones | Initial Release |

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