

FHS SERIES LENSES for LUXEON™ LEDs: LUXEON I, III, and V, STAR and EMITTER

- High efficiency
- Available in 4 different beams
- Patent Pending

The FHS series offers a complete range of lenses especially designed for the LUXEON™ LED from Lumileds (1). Both Batwing and Lambertian LUXEON™ radiation patterns are supported.

A software-optimized aspheric profile combined with front shaped micro-lens arrays enable the generation of four different lens models: narrow beam, medium beam, wide beam, and elliptical pattern (2).

The high collection efficiency reaches 85% of the total flux emitted from the LED.

Each of these lenses is available assembled with Fraen's universal Lens Holder. The holder assures the proper relative placement between the lens and the Luxeon™ LED. Heat staking the four legs of the holder to the customer's PCB or heat sink provides excellent optical and mechanical assembly (see Fraen Application Note FAN01-EN (at www.fraen.com)).

Typical applications are:

- Reading lamps
- Signs
- Architectural Lighting
- Street Lights
- Most application where uniformity and high intensity over a wide angle is required.



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

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

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General Characteristics

| | |
|-----------------------------|--------------------------|
| Lens Material | Optical Grade PMMA |
| Holder Material | PC ABS or Transparent PC |
| Operating Temperature range | -40deg C / + 80 deg C |
| Storage Temperature range | -40deg C / + 80 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: Total Beam Divergence

| <u>With Batwing LED</u> | | Typical total beam divergence (degrees) (3) | | | |
|-------------------------|-----------------|--|--|---|--|
| Lens Part Number | Type of lens | Red, Amber LEDs  | Blue, Cyan, Green LEDs  | White LEDs  | Warm White LEDs  |
| FHS-HNB1-LB01-z | Narrow beam | 6 | 8 | 8 | 8 |
| FHS-HMB1-LB01-z | Medium beam | 23 | 25 | 25 | 30 |
| FHS-HWB1-LB01-z | Wide beam | 45 | 45 | 45 | 45 |
| FHS-HEB1-LB01-z | Elliptical beam | 10 x 20 | 10 x 20 | 10 x 20 | 15 x 30 |

| <u>With Lambertian LEDs</u> | | Typical total beam divergence (degrees) (3) | | |
|-----------------------------|-----------------|--|--|---|
| Lens Part Number | Type of lens | Red, Orange, Amber LEDs  | Blue, Cyan, Green LEDs  | White LEDs  |
| FHS-HNB1-LL01-z | Narrow beam | 8 | 10 | 10 |
| FHS-HMB1-LL01-z | Medium beam | 25 | 28 | 30 |
| FHS-HWB1-LL01-z | Wide beam | 40 | 45 | 45 |
| FHS-HEB1-LL01-z | Elliptical beam | 12 x 24 | 12 x 24 | 12 x 24 |

(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.

Optical Characteristics: On-Axis Efficiency

| <u>With Batwing</u> LEDs | | Typical on-axis efficiency (cd/lm) (4)(5) | | | | | | |
|--------------------------|-----------------|---|-----------|------------|-------------|----------|------------|-----------------|
| Lens Part Number | Type of lens | Blue LEDs | Cyan LEDs | Green LEDs | Yellow LEDs | Red LEDs | White LEDs | Warm White LEDs |
| FHS-HNB1-LB01-z | Narrow beam | 31.9 | 31.9 | 31.9 | 40.2 | 40.2 | 27.2 | 13.5 |
| FHS-HMB1-LB01-z | Medium beam | 6.0 | 6.0 | 6.0 | 5.1 | 5.1 | 4.5 | 4.1 |
| FHS-HWB1-LB01-z | Wide beam | 1.7 | 1.7 | 1.7 | 1.5 | 1.5 | 1.6 | 1.6 |
| FHS-HEB1-LB01-z | Elliptical beam | 8.6 | 8.6 | 8.6 | 7.9 | 7.9 | 9.9 | 5.7 |

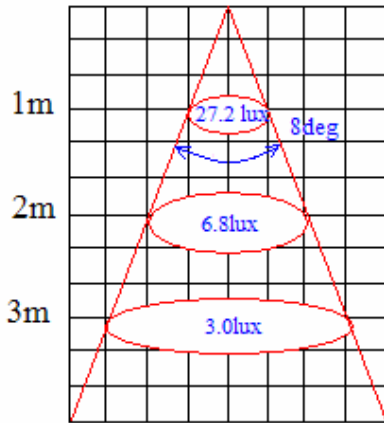
| <u>With Lambertian</u> LEDs | | Typical on-axis efficiency (cd/lm) (4)(5) | | | | | | |
|-----------------------------|-----------------|---|-----------|------------|-------------|-------------|----------|------------|
| Lens Part Number | Type of lens | Blue LEDs | Cyan LEDs | Green LEDs | Yellow LEDs | Orange LEDs | Red LEDs | White LEDs |
| FHS-HNB1-LL01-z | Narrow beam | 24.7 | 24.7 | 24.7 | 16.7 | 16.7 | 16.7 | 23.3 |
| FHS-HMB1-LL01-z | Medium beam | 5.2 | 5.2 | 5.2 | 4.3 | 4.3 | 4.3 | 5.5 |
| FHS-HWB1-LL01-z | Wide beam | 1.5 | 1.5 | 1.5 | 1.2 | 1.2 | 1.2 | 1.8 |
| FHS-HEB1-LL01-z | Elliptical beam | 7.7 | 7.7 | 7.7 | 9.6 | 9.6 | 6.4 | 7.5 |

(4) To estimate the on-axis intensity, multiply the on-axis efficiency of the lens (cd/lm) by the total flux of the Luxeon LED used. For more detail on flux binning please check the Luxeon LED datasheet at <http://www.luxeon.com>.

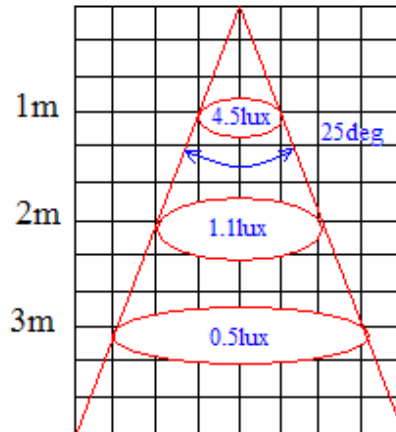
(5) Luminous intensity depends on the flux binning and tolerances of the LEDs. Please refer to the Luxeon datasheet for more details on flux binning and mechanical tolerances.

Illumination Charts ^(6,7)

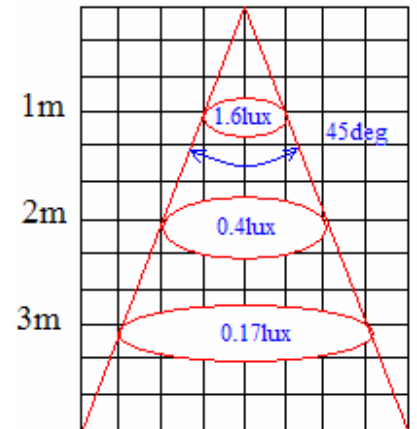
With FHS-HNB1-LB01-z lens:
Narrow beam lens for **Batwing**
 Luxeon LEDs



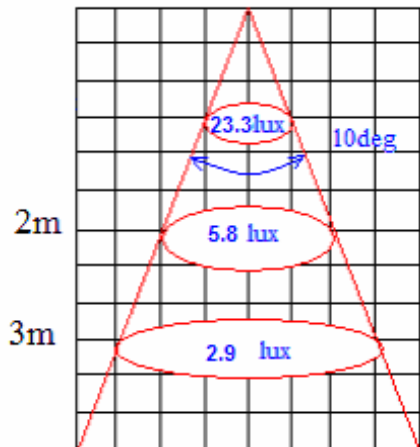
With FHS-HMB1-LB01-z lens:
Medium beam lens for **Batwing**
 Luxeon LEDs



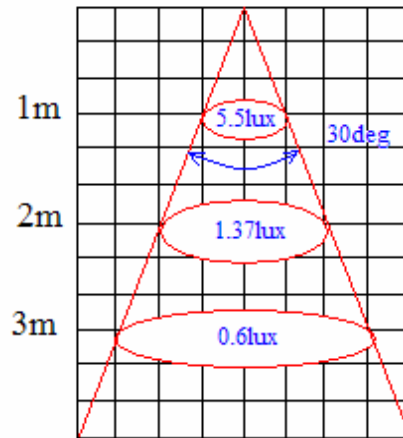
With FHS-HWB1-LB01-z lens:
Wide beam lens for **Batwing**
 Luxeon LEDs



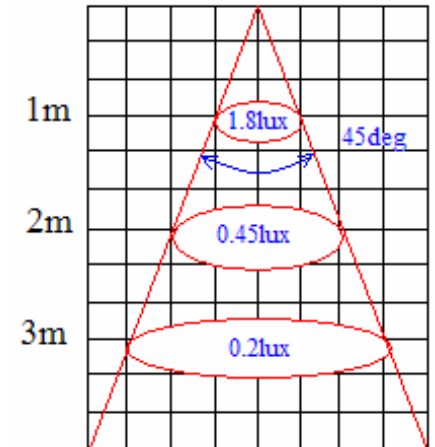
With FHS-HNB1-LL01-z lens:
Narrow beam lens for
Lambertian Luxeon LED



With FHS-HMB1-LL01-z lens:
Medium beam lens for
Lambertian Luxeon LED



With FHS-HWB1-LL01-z lens:
Wide beam lens for **Lambertian**
 Luxeon LED



Note: These values have been calculated using the efficiency values of the lens listed above and the formula $E = I / d^2$, where E is the irradiance in lux, I the intensity in cd, and d the distance between the lens output and the measured point.

(6) Typical illuminance measured in lux per lumen (E) with typical Luxeon™ LEDs. Based on White LED. To estimate the illuminance in lux, multiply the typical illuminance E by the flux in lumens of the LED used.

(7) Illuminance output depends on the flux binning and tolerances of the LEDs. Please refer to the Luxeon™ datasheet to verify the flux bin.

Mechanical Characteristics

IMPORTANT - Assembly information:

For best optical performance (shown above), correct mechanical position of the lens on the Luxeon LED is critical.

To achieve correct lens position with a Batwing Luxeon LED, you need to use:

- Either a lens alone, or a lens with a Batwing holder.

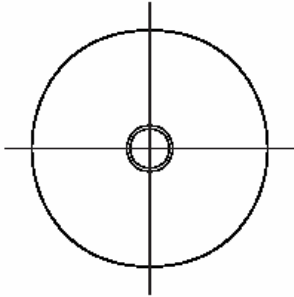
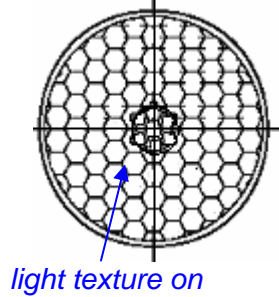
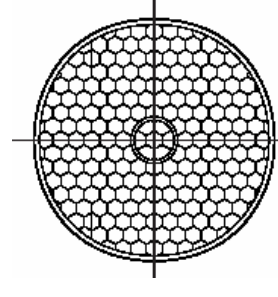
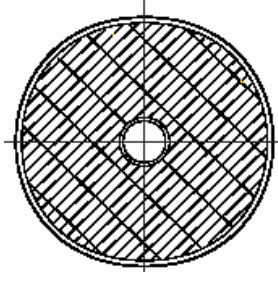
To achieve correct lens position with a Lambertian Luxeon LED, you need to use:

- Either a lens with a ring spacer, or a lens with a Lambertian holder.

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 "

Identifying Lenses by Their Appearance

The beam patterns of the lenses can be distinguished by their front views:

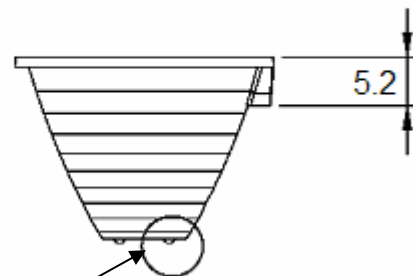
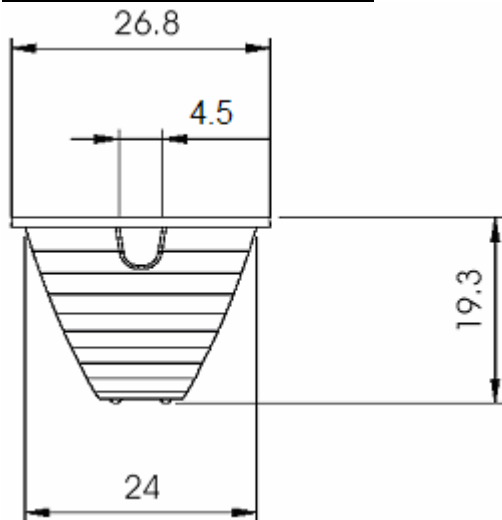
| Narrow beam lenses: FHS-HNB1-LB01-z FHS-HNB1-LL01-z | Medium Beam lenses: FHS-HMB1-LB01-z FHS-HMB1-LL01-z | Wide beam lenses: FHS-HWB1-LB01-z FHS-HWB1-LL01-z | Elliptical lenses: FHS-HEB1-LB01-z FHS-HEB1-LL01-z |
|---|---|--|---|
|  |  |  |  |
| Flat surface | 2.6mm hexagonal shaped microlens array | 1.7mm hexagonal shaped microlens array | 1.0 x 3.7mm rectangular shaped microlens array |

Note: The outside mechanical dimensions of all the **Batwing** lenses (Narrow, Medium, Wide and Elliptical beam) are equal, except the top surface of the lens. The outside mechanical dimensions of all the **Lambertian** lenses (Narrow, Medium, Wide and Elliptical beam) are equal, except the top surface of the lens.

(8) A light texture has been added to the microlens surface of the medium beam lenses. This texture improves homogeneity (evenness) of the beam with negligible affect on peak intensity.

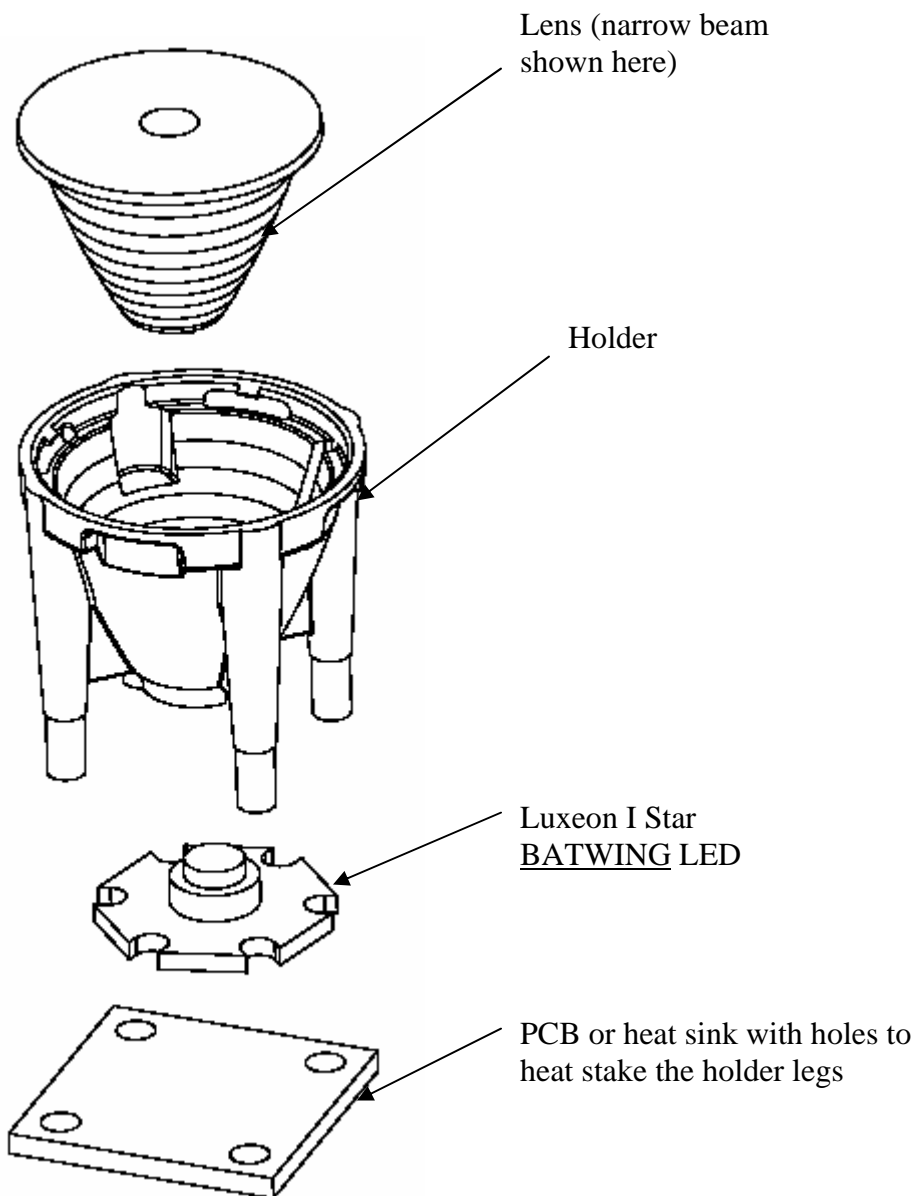
Mechanical Characteristics: using a Batwing Luxeon LED

Batwing Lens Drawings:

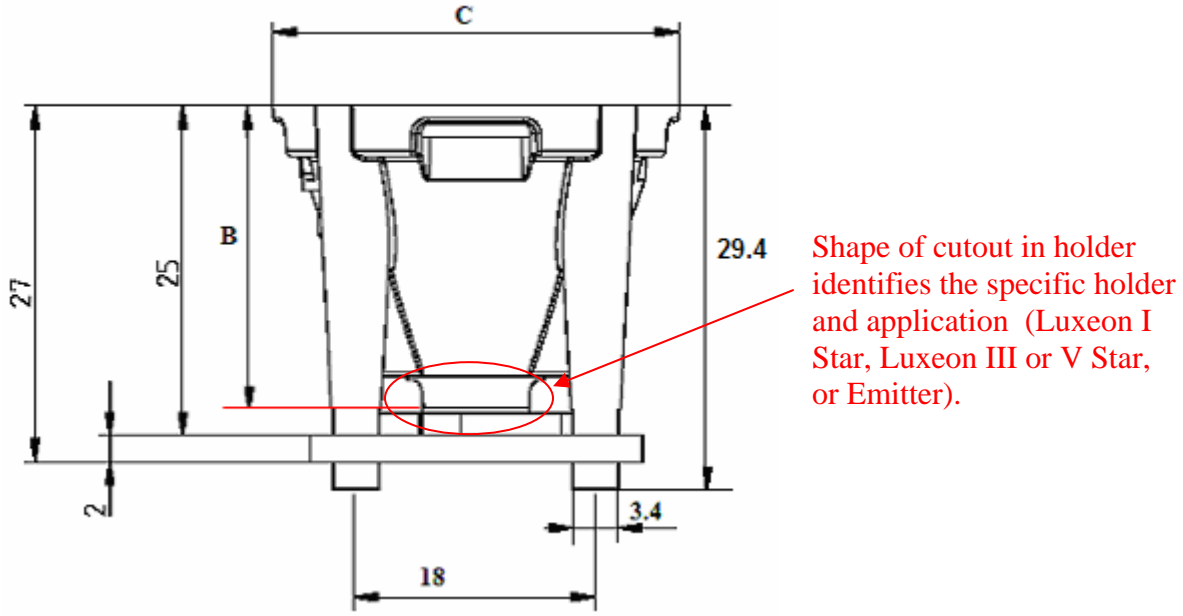


The 4 bumps on the bottom allow the lens to be mounted directly on the Batwing Luxeon LEDs.

Lens + holder assembly view:



Lens + holder assembly dimensions:



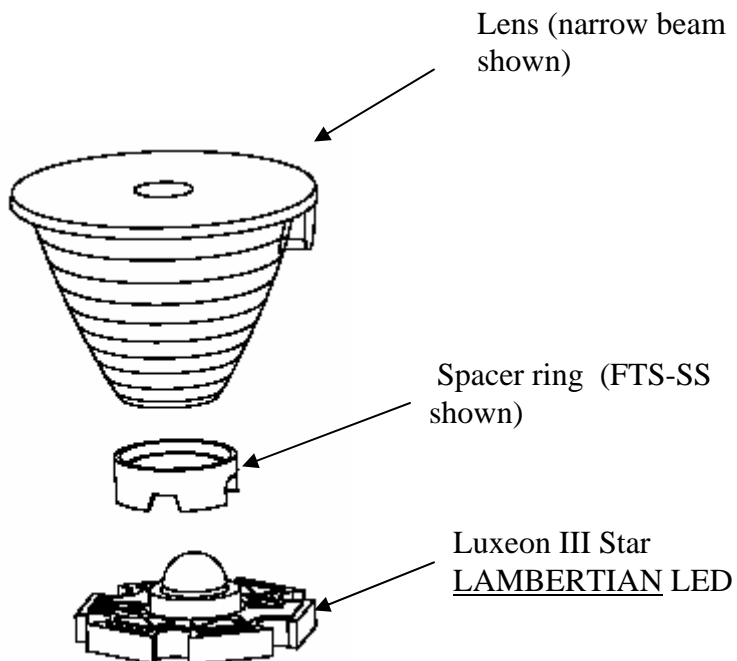
To achieve the correct distance between any Batwing Luxeon™ LED and the lens, specific holders should be used. The holders can be identified by their interface:

| Type of Batwing Luxeon LEDs used | Bottom of the holder | B | C Standard holder | C M11 holder version |
|----------------------------------|----------------------|--------|----------------------|-------------------------|
| Star or Emitter | | 23.0mm | 30.5mm | 34.9mm |
| Warm white Star | | 22.2mm | 30.5mm | 34.9mm |

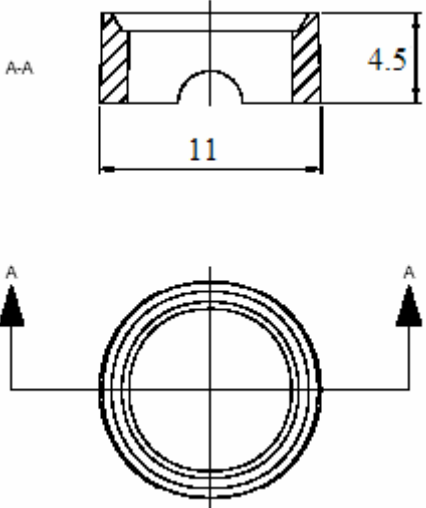
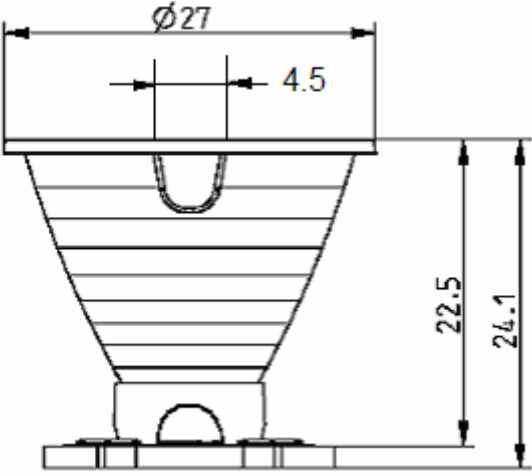
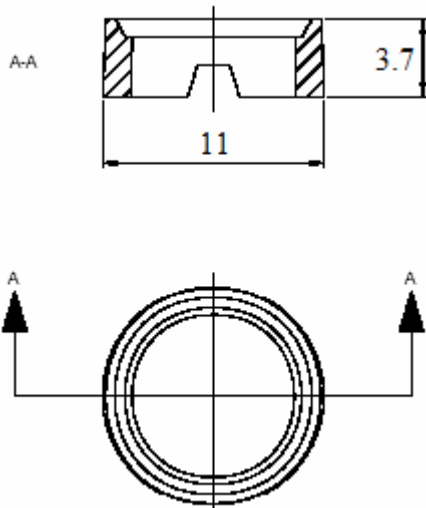
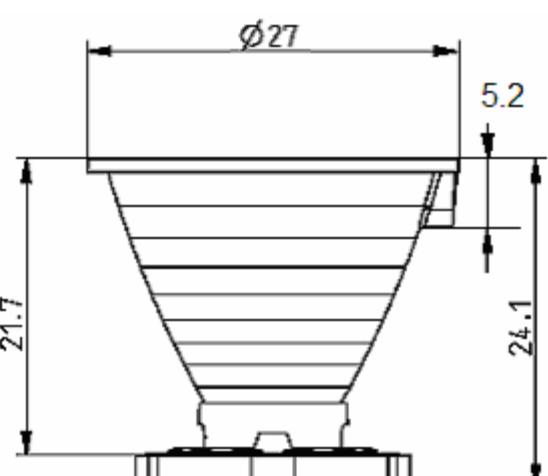
Dimensions tolerance is +/-0.2mm

Mechanical Characteristics: using a Lambertian Luxeon LED

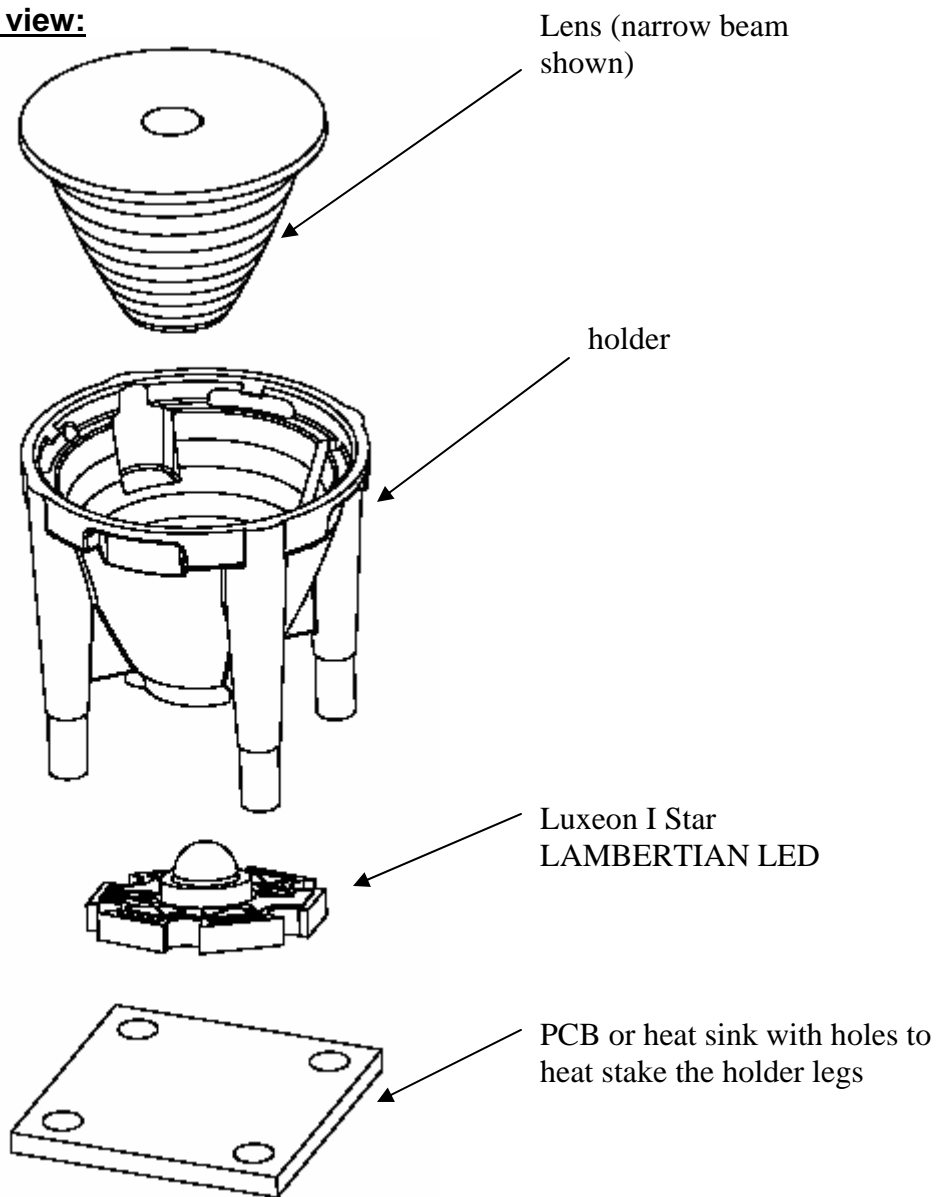
Lens + spacer ring assembly view:



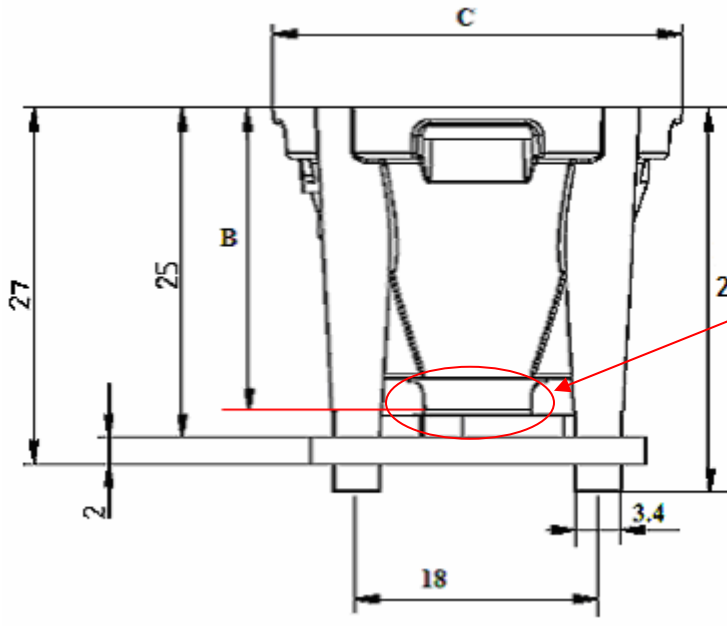
The ring spacers are only required for Lambertian lenses used without holders.

| | |
|--|--|
| <p>With the following Luxeon LEDs:</p> <ul style="list-style-type: none"> - Luxeon I Lambertian Star - Luxeon I Lambertian Emitter - Luxeon III Lambertian Emitter - Luxeon V Lambertian Emitter <p>Use Fraen spacer ring part number: <u>FTS-S</u></p> | <p>With the following LUXEON LEDs:</p> <ul style="list-style-type: none"> - Luxeon III Lambertian Star - Luxeon V Lambertian Star <p>Use Fraen spacer ring part number: <u>FTS-SS</u></p> |
| <p>FTS-S Spacer Ring:</p>  <p>Assembly:</p>  | <p>FTS-SS Spacer Ring:</p>  <p>Assembly:</p>  |

Lens + holder assembly view:



Lens + holder assembly dimensions:



Shape of cutout in holder identifies the specific holder and application (Luxeon I Star, Luxeon III or V Star, or Emitter).

To achieve the correct distance between any Lambertian Luxeon™ LEDs and the lens, specific holders have been designed. The holders are identified by their interface:

| Type of Lambertian Luxeon used | Bottom of the holder | B | C Standard holder | C M11 holder version |
|---|----------------------|--------|----------------------|-------------------------|
| Luxeon I Star Luxeon I Emitter Luxeon III Emitter Luxeon V Emitter | | 23.0mm | 30.5mm | 34.9mm |
| Luxeon III Star Luxeon V Star | | 23.8mm | 30.5mm | 34.9mm |

Dimensions tolerance is +/-0.2mm

Ordering part numbers – Lenses and Lenses Assembled to Holders

FHS-HxB1-yyyy-z

HOLDER OPTIONS:

- 0: Lens alone, requires spacer ring.
(CAUTION: Spacer ring FTS-S or FTS-SS must be used to set the correct gap between the lens and Luxeon LED)
- H: Lens assembled to plastic holder.
- M11: Lens assembled to MR11 holder, which has an MR11-sized flange.

LED TYPE:

- LB01: Luxeon I Batwing Star/Emitter
- LBSW: Luxeon I Batwing Star, Warm White
- LL01: Luxeon I Lambertian Star/Emitter and Luxeon III or V Lambertian Emitter
- LLS3: Luxeon III or V Lambertian Star. [Must be ordered as –LLS3-H (with holder). For lens only, order –LL01-0 and FTS-SS Spacer Ring].

LENS TYPE:

- N: Narrow beam lens
- M: Medium beam lens
- W: Wide beam lens
- E: Elliptical beam lens

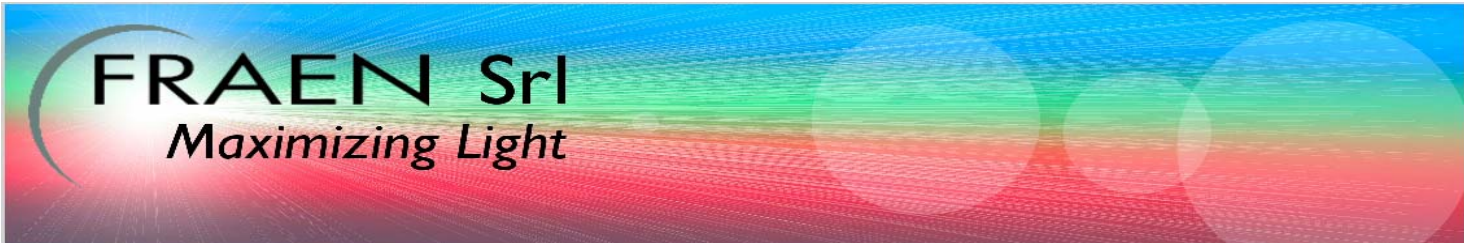
Ordering part numbers – Spacer Rings

FTS-S

- Use Spacer Ring **FTS-S** for:
- Luxeon I Lambertian Star
 - Luxeon I, III, or V Lambertian Emitter

FTS-SS

- Use Spacer Ring **FTS-SS** for:
- Luxeon **III** or **V** Lambertian **Star**



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Document Revision Record

| Rev | Date | Author | Description |
|------------|-------------|---------------|---|
| 00 | 11 June 02 | L Scodes | Initial Release |
| 01 | 01 March 05 | M Thorailler | Additional data and text added. |
| 02 | 02 May 05 | M Thorailler | Part numbering added for Luxeon III Star and Warm White LEDs |
| 03 | 31 July 06 | C Jones | <ul style="list-style-type: none">• Page 4: on-axis efficiency data for Lambertian white narrow increased from 19.8 to 23.3; chart page 5 changed accordingly.• Page 6: notes about texture added.• Page 14: Spacer Ring part numbers added to ordering info. |