FHS Lens Series
for Cree XLamp XP-E LEDs

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

The FHS series offers a complete range of lenses especially designed for the XLamp XP-E LED from Cree[1]

A software-optimized aspheric profile combined with front shaped micro-lens arrays enable the generation of four different beam profiles: Narrow, Medium, Wide and Elliptical[2].

The design of the FHS series insures that almost all of the light emitted by the LED is captured and usefully directed, resulting in a lens with maximum performance and efficiency.

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 LED. Heat staking the four legs of the holder to the customer's PCB or heat sink provides excellent optical and mechanical assembly and stability.

Typical applications are:

- Reading lamps
- Signs
- Architectural Lighting
- Exterior Lighting
- Applications where beam uniformity and high intensity are required

1. Cree® XLamp is a trademark of Cree, Inc. For technical information about these LEDs, please refer to the Cree® XLamp datasheet or visit: http://www.cree.com/products/xlamp.asp
2. Beam angles may vary with LED color, LED binning and LED position

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General Characteristics

Materials

Lens Material	Optical Grade PMMA
Holder Material	Polycarbonate: White
Operating Temperature range	-40° C / + 80° C
Storage Temperature range	-40° C / + 80°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 tri-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 solvents such as alcohol, as it will damage the plastic.*

Scope

This datasheet provides information about the FHS series lens and lens assemblies for Cree XLamp XP-E.

- FHS-N1-SPL-0R Narrow Beam lens (No holder)
- FHS-M1-SPL-0R Medium Beam lens (No holder)
- FHS-W1-SPL-0R Wide Beam lens (No holder)
- FHS-E1-SPL-0R Elliptical Beam lens (No holder)

- FHS-N1-SPL-HRL Narrow Beam lens in a holder
- FHS-M1-SPL-HRL Medium Beam lens in a holder
- FHS-W1-SPL-HRL Wide Beam lens in a holder
- FHS-E1-SPL-HRL Elliptical Beam lens in a holder

Optical Characteristics – On-axis Intensity[1], Beam Angle[2], Field Angle[3]

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)
XP-E Warm White	Narrow	29.8 cd/lm	7.5°	20°
	Medium	4.7 cd/lm	23°	40°
	Wide	1.9 cd/lm	32°	68°
	Elliptical	TBD	TBD	TBD
XP-E Cool White	Narrow	27.1 cd/lm	7.5°	17°
	Medium	4.9 cd/lm	22°	39°
	Wide	1.8 cd/lm	36°	66°
	Elliptical	TBD	TBD	TBD
XP-E Neutral White	Narrow	24.5 cd/lm	8.5°	18°
	Medium	5.3 cd/lm	22°	37°
	Wide	1.9 cd/lm	32°	70°
	Elliptical	TBD	TBD	TBD
XP-E Red	Narrow	22.9 cd/lm	8.5°	19°
	Medium	5.3 cd/lm	22°	38°
	Wide	1.8 cd/lm	43°	68°
	Elliptical	TBD	TBD	TBD
XP-E Green	Narrow	29.0 cd/lm	8°	16°
	Medium	5.0 cd/lm	22°	38°
	Wide	1.5 cd/lm	45°	66°
	Elliptical	TBD	TBD	TBD
XP-E Blue	Narrow	22.8 cd/lm	8°	17°
	Medium	3.8 cd/lm	22°	39°
	Wide	1.1 cd/lm	46°	65°
	Elliptical	TBD	TBD	TBD

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)
XP-E Amber	Narrow	25.2 cd/lm	8.5°	18°
	Medium	5.4 cd/lm	22°	39°
	Wide	1.7 cd/lm	43°	63°
	Elliptical	TBD	TBD	TBD

(1) To calculate the on-axis intensity (cd), multiply the on-axis intensity value (cd/lm), above, of the lens by the total flux (lm) of the LED used. See "Example Calculations" below. Luminous intensity depends on the drive current, color temperature, flux binning and tolerances of the LEDs. Please refer to the LED datasheet for more details.
(2) FWHM is the full angle where the beam intensity is half the on-axis peak intensity
(3) Field angle is the full angle where the beam intensity is 10% of the on-axis peak intensity

Example Calculations

To calculate intensity (cd): Find the central spot on-axis intensity (cd/lm) for the lens and then multiply this value by the luminous flux (lm) of the LED. Refer to the LED's datasheet for typical flux values; drive current versus flux ratios; color temperature and binning characteristics.

Example intensity calculations:

If a Fraen lens with an on-axis intensity of 21 candela per lumen (cd/lm) is used with an LED that produces 105 lumens of flux, the calculations are as follows:

On-axis intensity = (21 cd/lm) x (105 lumens) = 2205 candela on-axis intensity (one LED).

If 12 LEDs are used in a fixture, then the on-axis intensity = 12 LEDs x 2205 candela/LED
= 26460 cd (on-axis – 12 LEDs)

An explanation of illuminance and the effect of distance

One candela at 1-meter distance produces 1 lux. In the above example, the 12 LED fixture produced 26460 candela. If that fixture is illuminating a surface one meter distant, then the *illuminance* on that surface is 26460 lux.

Illuminance decreases with the square of the distance. If you move the fixture so that it is two meters from the surface, then the illuminance falls to 26460 lux/ $(2m)^2$ or 6615 lux. Moving the fixture three meters from the surface decreases the illuminance to 26460 lux/$(3m)^2$ or 2940 lux.

Beam and Field Angles

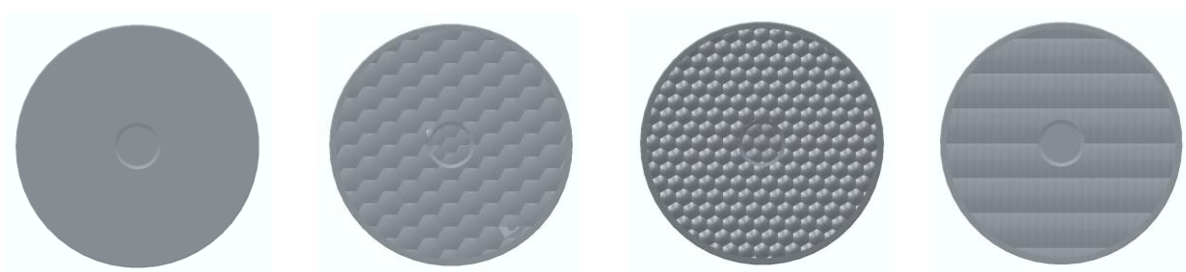
Beam and Field Angles are methods of describing the light distribution of a lens. The Beam Angle is expressed as a FWHM value (Full angular Width of the beam where it reaches Half the Maximum intensity). The Field Angle is a similar concept, sometimes expressed as FW10%, and represents the Full Width angle where the beam reaches 10% of maximum intensity.

If the lenses in our example fixture, above, have a Beam Angle of 10° and an on-axis intensity of 26460 cd, then at ± 5° (half of 10°) the intensity will drop to half of 26460 or 13230 cd. If the Field Angle for the fixture is 19°, then at ± 9.5° (half of 19°) the intensity should be 10% of 26460 or 2646 cd.

Most lenses have Beam and Field Angles that are rotationally symmetrical about the center axis of the lens. Lenses with an elliptical beam profile or optics with specifically shaped beam profiles are the exception.

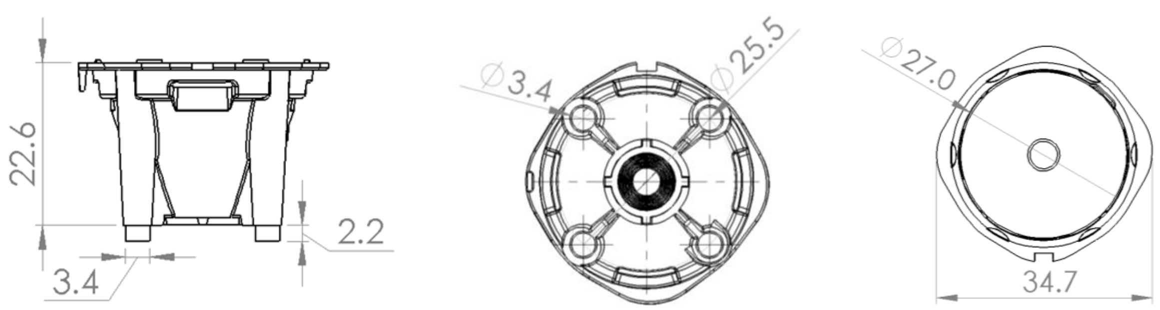
Intensity, illuminance, Beam and Field Angle are all important factors to be considered in a fixture design. Some applications may require specific ratios between the Beam and Field Angle values.

Mechanical Characteristics



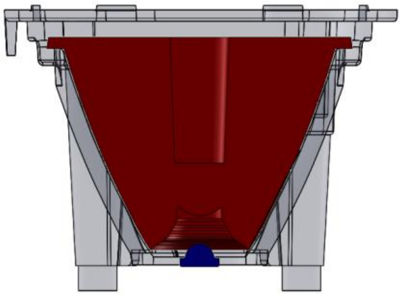
FHS-N1-SPL-0R | FHS-M1-SPL-0R | FHS-W1-SPL-0R | FHS-E1-SPL-0R

Figure 1. Identifying the lenses by their front view

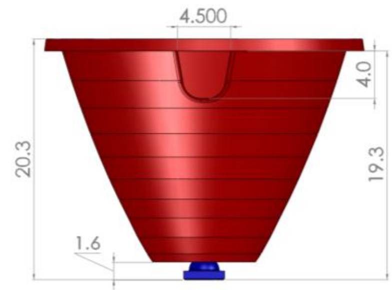


All dimensions in millimeters

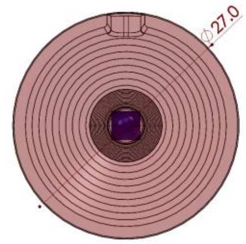
Figure 2. Layout features and dimensions of the lens assembly (lens in a holder)



Assembly: Cross section



Lens: Side view showing lens gate



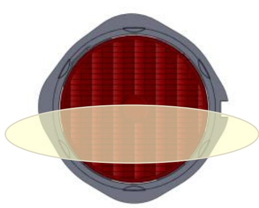
Lens: Top view

All dimensions in millimeters

Figure 3. Showing relationships between the LED and a properly positioned lens

The FHS holder features alignment legs that are inserted into the PCB. The holder legs have shoulders that limit the depth of insertion to establish the correct lens height above the LED.

NOTE: If the FHS lens is used with no lens holder, the user must provide a mechanical method to set the correct position of the lens on the LED. When properly located, the FHS lens is centered on the LED dome and is 1.6mm above the PCB surface.



The FHS elliptical lens produces a beam whose long axis is perpendicular to the micro-lens ribbing on the output face of the lens.

The relationship between the elliptical beam orientation, the lens holder, the lens legs and the PCB are important design considerations.

Figure 4. Elliptical lens design considerations

Ordering Part Numbers

FHS-N1-SPL-0R	**Narrow Beam lens (No holder)**
FHS-M1-SPL-0R	**Medium Beam lens (No holder)**
FHS-W1-SPL-0R	**Wide Beam lens (No holder)**
FHS-E1-SPL-0R	**Elliptical Beam (No holder)**
FHS-N1-SPL-HRL	**Narrow Beam lens in a holder**
FHS-M1-SPL-HRL	**Medium Beam lens in a holder**
FHS-W1-SPL-HRL	**Wide Beam lens in a holder**
FHS-E1-SPL-HRL	**Elliptical Beam lens in a holder**

Published by Fraen Corporation.