FCP Lens Series
for Cree XLamp[1] LEDs

- **High efficiency design**
- **5 beams patterns available**
- **Available as a lens alone for maximum design flexibility or in a holder for easy assembly**

The FCP lens offers low profile lenses designed for compatibility with the XLamp LEDs from Cree Corporation.

A software-optimized aspheric profile enables the generation of several different beam output patterns: narrow, medium, wide, medium elliptical and wide elliptical beams[2].

The design of the FCP 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.

Lens holders are available in black, white or transparent polycarbonate to provide the proper alignment between the LEDs and the lenses, and to set the correct distance between the lens and LED.

The lens holder can be glued and/or screwed to the PCB to provide a secure assembly.

Typical applications are:

- Reading lamps
- Architectural lighting
- Entertainment lighting
- Interior lighting
- Portable lighting

(1) Cree® XLamp is a trademark of Cree, Inc. For technical information about these LEDs, please refer to the Cree® XLamp datasheet or visit: www.cree.com.
(2) Typical beam divergence varies with LED type and color.

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General Characteristics

Materials

Lens Material	Optical Grade PMMA
Holder Material	Polycarbonate
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 3 mm 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 – Lens 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. Never expose the lenses to solvents such as alcohol, which can damage the plastic.*

Scope

This datasheet provides information about the FCP lens series for Cree XLamp LEDs.

Lens alone:

- FCP-N1-XPE1-0R
- FCP-M1-XPE1-0R
- FCP-W1-XPE1-0R
- FCP-E1-XPE1-0R
- FCP-E2-XPE1-0R

Lens Assemblies (lenses in holders):

Black Holder	White Holder	Transparent Holder
FCP-N1-XPE1-HRF	FCP-N1-XPE1-HRFW	FCP-N1-XPE1-HRFT
FCP-M1-XPE1-HRF	FCP-M1-XPE1-HRFW	FCP-M1-XPE1-HRFT
FCP-W1-XPE1-HRF	FCP-W1-XPE1-HRFW	FCP-W1-XPE1-HRFT
FCP-E1-XPE1-HRF	FCP-E1-XPE1-HRFW	FCP-E1-XPE1-HRFT
FCP-E2-XPE1-HRF	FCP-E2-XPE1-HRFW	FCP-E2-XPE1-HRFT

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Optical Characteristics – On-axis Intensity[3], Beam Angle[4], Field Angle[5]

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)
XB-D* Warm White	Narrow	13.0 cd/lm	11°	23°
	Medium	3.7 cd/lm	22°	40°
	Wide	2.1 cd/lm	43°	57°
	Wide Elliptical	4.7 cd/lm	12° x 33°	35° x 48°
	Medium Elliptical	6.8 cd/lm	11° x 23°	24° x 42°
XP-C Cool White	Narrow	57 cd/lm	5°	12°
	Medium	4 cd/lm	23°	40°
	Wide	*Not Approved*	*Not Approved*	*Not Approved*
	Wide Elliptical	8 cd/lm	7° x 33°	18° x 42°
	Medium Elliptical	13 cd/lm	7° x 22°	18° x 39°
XP-C Warm White	Narrow	51 cd/lm	6°	14°
	Medium	4 cd/lm	23°	40°
	Wide	*Not Approved*	*Not Approved*	*Not Approved*
	Wide Elliptical	7 cd/lm	8° x 33°	20° x 44°
	Medium Elliptical	13 cd/lm	8° x 22°	20° x 40°
XP-C Red Green Blue	Narrow	**48 55 43** cd/lm	6°	13°
	Medium	**4 4 3** cd/lm	23°	39°
	Wide	*Not Approved*	*Not Approved*	*Not Approved*
	Wide Elliptical	**8 8 6** cd/lm	7° x 33°	18° x 43°
	Medium Elliptical	**12 12 9** cd/lm	9° x 23°	19° x 40°
XP-E Cool White	Narrow	26 cd/lm	9°	18°
	Medium	4 cd/lm	23°	40°
	Wide	2.6 cd/lm	32°	55°

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)
XP-E Cool White	Wide Elliptical	6 cd/lm	10° x 34°	21° x 45°
	Medium Elliptical	10 cd/lm	10° x 23°	21° x 41°
XP-E Warm White	Narrow	26 cd/lm	9°	18°
	Medium	4 cd/lm	23°	40°
	Wide	2.5 cd/lm	31°	55°
	Wide Elliptical	6 cd/lm	10° x 34°	21° x 46°
	Medium Elliptical	10 cd/lm	10° x 23°	22° x 40°
XP-E Red Green Blue	Narrow	**22 16 22** cd/lm	9°	17°
	Medium	**4 4 3** cd/lm	23°`	39°
	Wide	**2.3 2.6 1.9** cd/lm	31°	54°
	Wide Elliptical	**6 6 5** cd/lm	10° x 34°	20° x 46°
	Medium Elliptical	**7 9 7** cd/lm	10° x 23°	21° x 41°
XP-E2 Cool White	Narrow	22 cd/lm	9°	18°
	Medium	3.5 cd/lm	20°	38°
	Wide	1.4 cd/lm	38°	58°
	Wide Elliptical	4.0 cd/lm	10° x 40°	20° x 52°
	Medium Elliptical	†	†	†
XP-G and XP-G2 Cool White	Narrow	13 cd/lm	13°	23°
	Medium	3.0 cd/lm	23°	42°
	Wide	1.8 cd/lm	37°	60°
	Wide Elliptical	4.0 cd/lm	14° x 38°	26° x 54°
	Medium Elliptical	6 cd/lm	13° x 19°	27° x 43°

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)
XP-G and XP-G2 Warm White ○	Narrow	14 cd/lm	14°	24°
	Medium	4.0 cd/lm	23°	42°
	Wide	2.0 cd/lm	38°	62°
	Wide Elliptical	4.0 cd/lm	14° x 38°	27° x 54°
	Medium Elliptical	7.0 cd/lm	13° x 24°	27° x 44°
XH-P 35 HD Warm White ○	Narrow	*Not Approved*	*Not Approved*	*Not Approved*
	Medium	2.2 cd/lm	26°	51°
	Wide	1.4 cd/lm	36°	67°
	Wide Elliptical	2.3 cd/lm	20° x 37°	39° x 67°
	Medium Elliptical	†	†	†
XH-P 35 HI Warm White ○	Narrow	8.0 cd/lm	14°	28°
	Medium	2.5 cd/lm	23°	48°
	Wide	1.2 cd/lm	36°	61°
	Wide Elliptical	2.5 cd/lm	17° x 41°	30° x 60°
	Medium Elliptical	†	†	†

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)
XQ-E HI * Warm White	Narrow	23.7 cd/lm	7°	15°
	Medium	3.6 cd/lm	20°	42°
	Wide	1.4 cd/lm	42°	60°
	Wide Elliptical	4.3 cd/lm	10° x 42°	19° x 52°
	Medium Elliptical	†	†	†

(3) To calculate the on-axis intensity in candelas (cd), multiply the on-axis candela per lumen value, above, of the lens (cd/lm) by the total luminous flux in lumens (lm) of the LED used. Luminous intensity depends on the flux binning and tolerance of the LEDs. Please refer to the LED datasheet for more details on flux binning.

(4) Beam angle is the full angle where the beam intensity is half the on-axis peak intensity.

(5) Field angle is the full angle where the beam intensity is 10% of the on-axis peak intensity.

† Contact Fraen

* For this LED package geometry, the Fraen lens holder discussed in this datasheet can be used to achieve the correct lens height, but cannot be used to achieve proper alignment/orientation of the lens on the LED die. This is because the lens holder alignment features are larger than the LED package geometry.

Example Calculations

To calculate intensity in candela (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 datasheet for typical flux values, drive current versus flux ratios, and color temperature and binning characteristics.

Example intensity calculations:

If a Fraen lens with an on-axis intensity of 23 candela per lumen (cd/lm) is used with an LED that produces 165 lumens of flux, the calculations are as follows:

On-axis intensity = (23 cd/lm) x (165 lumens) = 3795 candela on-axis intensity (one LED).

If 12 LEDs are used in a fixture, then the on-axis intensity = 12 LEDs x 3795 candela/LED
= 45540 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 45540 candela. If that fixture is illuminating a surface one meter distant, then the *illuminance* on that surface is 45540 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 45540 lux/ $(2m)^2$ or 11385 lux. Moving the fixture three meters from the surface decreases the illuminance to 45540 lux/$(3m)^2$ or 5060 lux.

Beam and Field Angles

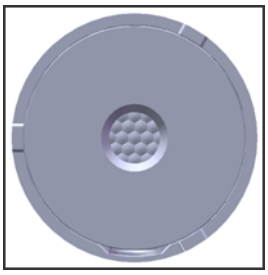
Beam and Field Angles are methods of describing the light distribution of a lens. The Beam Angle is expressed as a FWHM value (Full angular Width of the beam where it reaches Half the Maximum intensity). The Field Angle is a similar concept, sometimes expressed as FW10%, and represents the Full Width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

If the lenses in our example fixture, above, have a Beam Angle of 7° and an on-axis intensity of 45540 cd, then at ± 3.5° (half of 7°) the intensity will drop to half of 45540 or 22770 cd. If the Field Angle for the fixture is 15°, then at ± 7.5° (half of 15°) the intensity should be 10% of 45540 or 4554 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 an 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



Narrow
Polished front face

Medium
Textured micro-lenses

Wide
Polished micro-lenses

Wide Elliptical
Has *13* ribs

Medium Elliptical
Has *11* ribs

Figure 1. Identifying the FCP series lenses by their front appearance.

The FCP series lenses are available assembled with holder or without a holder. The holder provides the correct alignment (concentricity, height, and orientation) of the lens to the LED. Orientation control is important for the elliptical beam lens.

NOTE: If the FCP lens is used without a lens holder, the user must provide a mechanical method to set the correct position of the lens on the LED. For example, the lens flange can be located in the lamp housing to center the lens to the LED and establish 10.9 mm from the bottom of the lens flange to the user's printed circuit board.

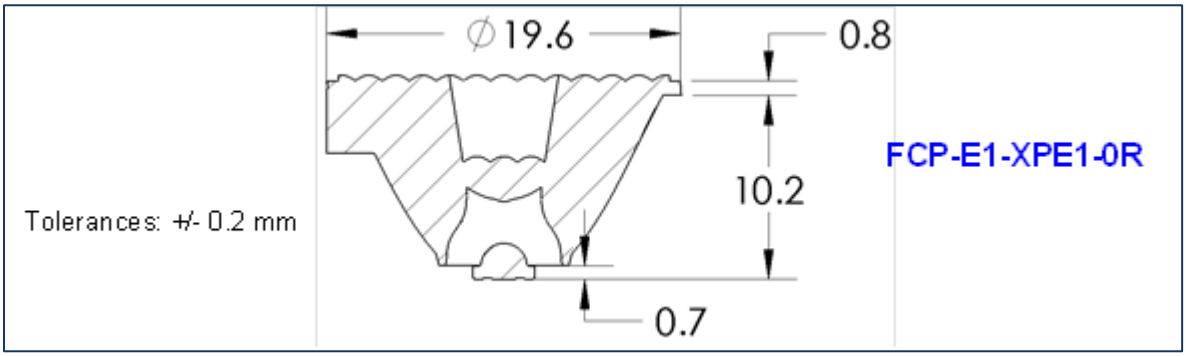
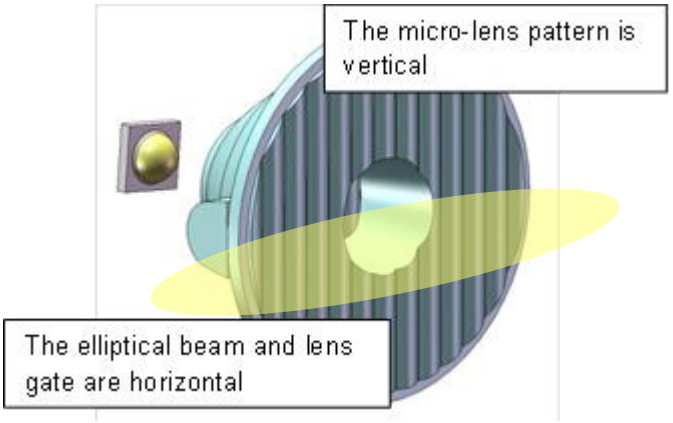
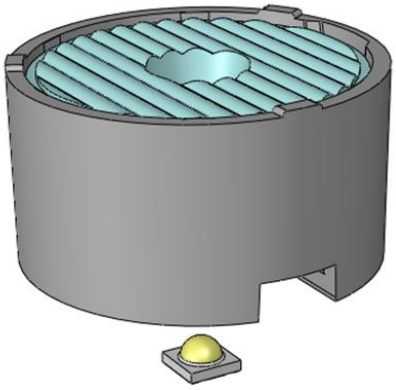


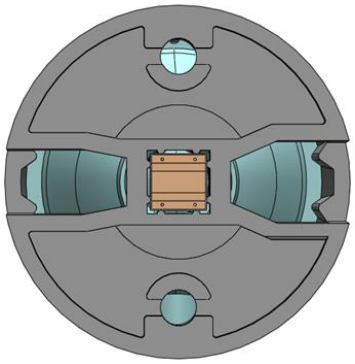
Figure 2. Lens position/height on LED



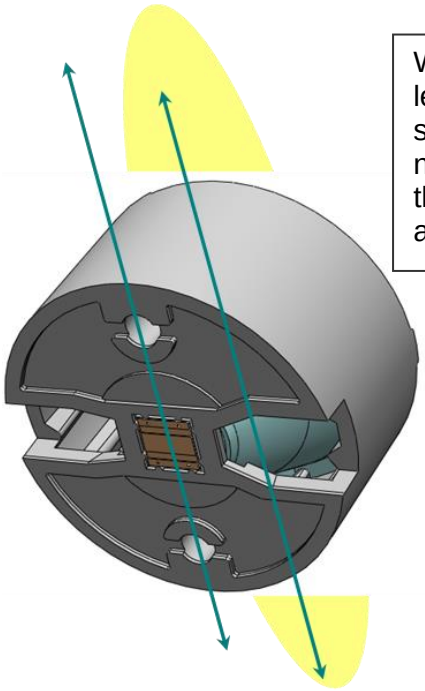
The elliptical beam lens produces a beam shape that is perpendicular to the microlens pattern on the output face of the lens. It is important to consider the orientation of the LEDs and the desired elliptical beam orientation when designing the printed circuit board layout.

Figure 3. Orientation of elliptical beam

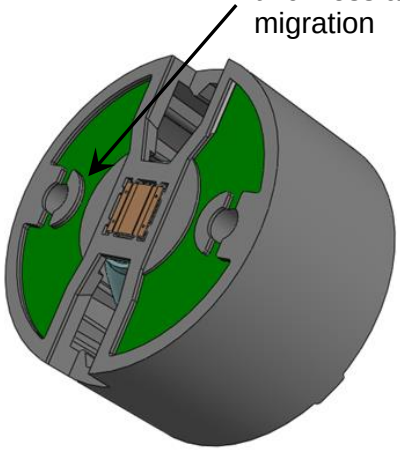




The FCP-_1-XPE1-HRF lens assemblies will fit onto the Cree LEDs at four orientations: 0°, 90°, 180° and 270°. The holder insures proper alignment (concentricity and height) of the lens to the LED. After installation, the bottom of the holder should be at the same datum/plane as the bottom of the Cree LED.



When attaching elliptical lens assemblies with screws, it is important to note that the long axis of the beam is parallel to the axis of the screw holes.



The lens assembly can be secured to the PC board by using glue or screws inserted through the PCB. 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.

Figure 4. Orientation and mounting of lens+holder assembly

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.

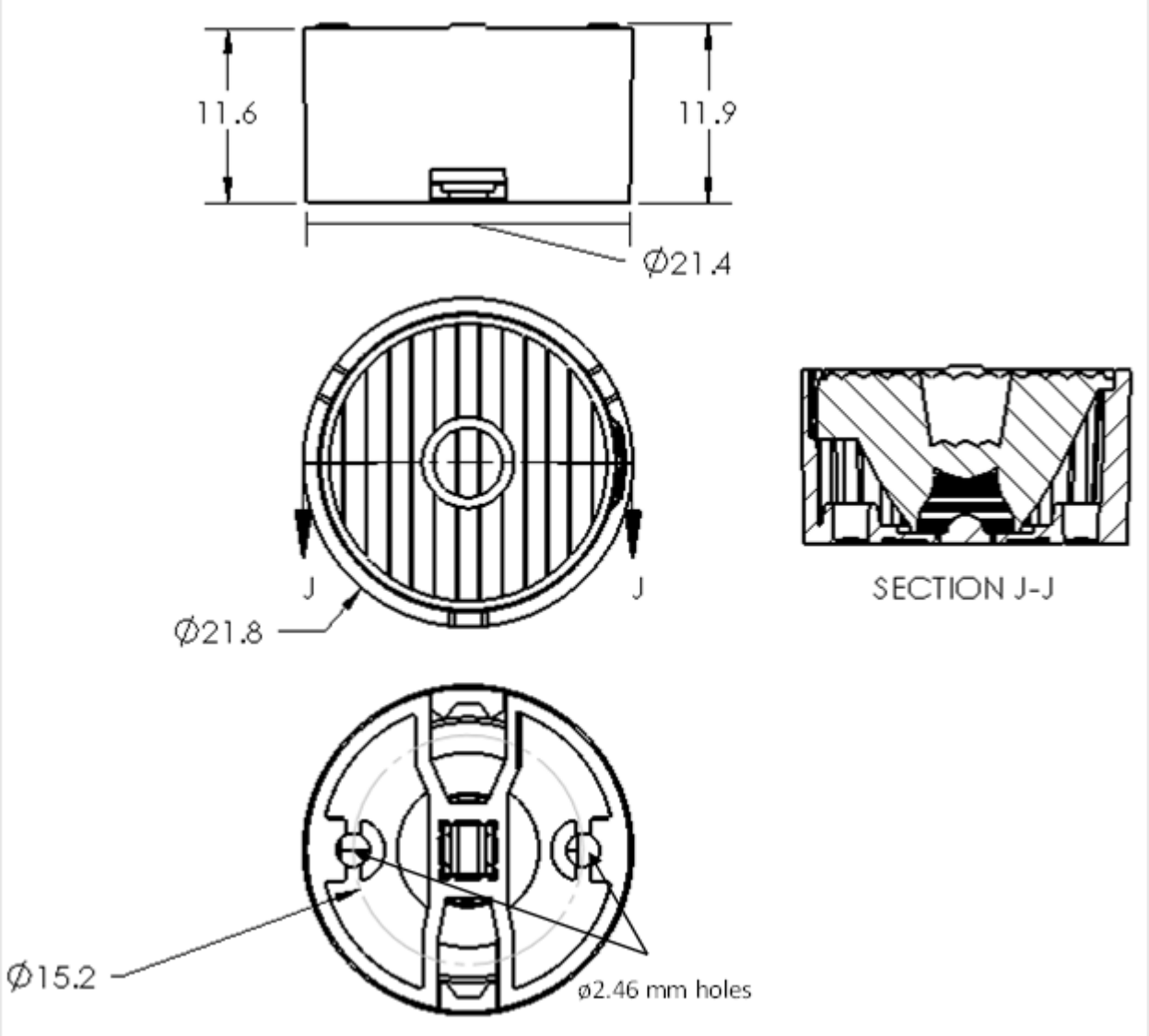


Figure 5. Overall dimensions of FCP-_n-XPE1-HRF series lens assemblies

Ordering Part Numbers

For lens only (no holder)

Caution: *if using lens alone, the user must set lens alignment and spacing. See Figure 2.*

FCP-_1-XPE1-0R

N: Narrow beam
M: Medium beam
W: Wide beam

FCP-E_-XPE1-0R

1: 10° x 34° Wide Elliptical (XP-E Warm White, other colors may vary)
2: 10° x 23° Medium Elliptical (XP-E Warm White, other colors may vary)

For assembly (lens + holder)

FCP-_1-XPE1-HRF (Black Holder)
-HRFW (White Holder)
-HRFT (Transparent Holder)

N: Narrow beam
M: Medium beam
W: Wide beam

FCP-E_-XPE1 -HRF (Black Holder)
-HRFW (White Holder)

1: 10° x 34° Wide Elliptical (XP-E Warm White, other colors may vary)
2: 10° x 23° Medium Elliptical (XP-E Warm White, other colors may vary)

Caution: The orientation of the elliptical beam lens is controlled by the lens holder (see Figures 3 thru 5).

For assistance, please contact Fraen http://www.fraen.com/optics/contact-us/.