FLP Lens Series
for LUXEON[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 LUXEON LEDs from Philips Lumileds.

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 FLP 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) For technical specification on Philips Lumileds LEDs please refer to the product datasheet or visit www.philipslumileds.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 Philips Lumileds LUXEON LEDs.

Lens alone:

• FLP-N4-RE-0R	Lens only: Narrow Beam
• FLP-M4-RE-0R	Lens only: Medium Beam
• FLP-W4-RE-0R	Lens only: Wide Beam
• FLP-E4-RE-0R	Lens only: Wide Elliptical Beam
• FLP-E5-RE-0R	Lens only: Medium Elliptical Beam

Lens Assemblies (lenses in holders):

Black Holder	White Holder	Transparent Holder
FLP-N4-RS-HRF	FLP-N4-RS-HRFW	FLP-N4-RS-HRFT
FLP-M4-RS-HRF	FLP-M4-RS-HRFW	FLP-M4-RS-HRFT
FLP-W4-RS-HRF	FLP-W4-RS-HRFW	FLP-W4-RS-HRFT
FLP-E4-RS-HRF	FLP-E4-RS-HRFW	FLP-E4-RS-HRFT
FLP-E5-RS-HRF	FLP-E5-RS-HRFW	FLP-E5-RS-HRFT

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%)	Distance, "D"
LUXEON A White	Narrow	12.5 cd/lm	13°	25°	.6 mm
	Medium	4.0 cd/lm	24°	44°	
	Wide	1.6 cd/lm	40°	63°	
	Medium Elliptical	6.6 cd/lm	13° x 28°	26° x 44°	
	Wide Elliptical	4.0 cd/lm	13° x 45°	26° x 68°	
LUXEON R White	Narrow	12.2 cd/lm	14°	25°	.6 mm
	Medium	4.0 cd/lm	24°	44°	
	Wide	1.6 cd/lm	41°	63°	
	Medium Elliptical	6.6 cd/lm	13° x 28°	26° x 44°	
	Wide Elliptical	4.0 cd/lm	13° x 45°	27° x 68°	
LUXEON Rebel Cool Neutral White	Narrow	20.4 cd/lm	11°	19°	.6 mm
	Medium	4.3 cd/lm	24°	42°	
	Wide	1.6 cd/lm	41°	61°	
	Medium Elliptical	9.0 cd/lm	9° x 28°	21° x 42°	
	Wide Elliptical	5.3 cd/lm	10° x 47°	22° x 64°	
LUXEON Rebel ES Cool Neutral White	Narrow	12.8 cd/lm	14°	25°	.6 mm
	Medium	4.0 cd/lm	24°	44°	
	Wide	1.5 cd/lm	41°	63°	
	Medium Elliptical	6.7 cd/lm	13° x 28°	25° x 44°	
	Wide Elliptical	4.1 cd/lm	13° x 45°	26° x 67°	
LUXEON Rebel Plus White	Narrow	20.2 cd/lm	10°	19°	.6 mm
	Medium	4.3 cd/lm	24°	42°	
	Wide	1.6 cd/lm	41°	61°	
	Medium Elliptical	8.9 cd/lm	9° x 28°	21° x 41°	
	Wide Elliptical	5.3 cd/lm	10° x 47°	22° x 64°	
LUXEON T*	Narrow	9.5 cd/lm	14°	25°	.7 mm
	Medium	3.1 cd/lm	22°	44°	
	Wide	1.5 cd/lm	37°	62°	
	Medium Elliptical	†	†	†	
	Wide Elliptical	3.4	12° x 41°	28° x 59°	

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)	Distance, "D"
LUXEON TX*	Narrow	8.1	13	27	.7 mm
	Medium	2.4	23	47	
	Wide	1.4	36	63	
	Medium Elliptical	†	†	†	
	Wide Elliptical	2.7	17 x 40	32 x 61	
LUXEON C*	Narrow	19	10	17	.4 mm
	Medium	3.6	20	41	
	Wide	1.4	42	62	
	Medium Elliptical	†	†	†	
	Wide Elliptical	4.5	10 x 43	19 x 54	
LUXEON Z*	Narrow	39	6	12	.3 mm
	Medium	3.6	20	41	
	Wide	1.5	44	61	
	Medium Elliptical	†	†	†	
	Wide Elliptical	6	7 x 42	17 x 50	
LUXEON Z ES*	Narrow	25	8	15	.7 mm
	Medium	3.7	20	41	
	Wide	1.5	42	61	
	Medium Elliptical	†	†	†	
	Wide Elliptical	1.5	9 x 42	21 x 51	

(3) Typical performance. Optical characteristics may change with LED color, color temperature and binning

(4) To calculate the on-axis intensity (cd), multiply the on-axis value, above, of the lens (cd/lm) by the total flux (lm) of the LED used. See "Example Calculations" below. Luminous intensity depends on the flux binning and tolerances of the LEDs. Please refer to the LED datasheet for more details on flux binning.

(5) FWHM is the full angle where the beam intensity is half the on-axis peak intensity.

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

† Contact Fraen for data.

* For LEDs marked with the asterisk (*), the Fraen lens holder discussed in this datasheet is not recommended, due to the required LED to PCB distance, "D" (see figure 2). For all LEDs discussed in the table not marked with the asterisk (*), the optic can be used with or without the holder.

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 39 candela per lumen (cd/lm) is used with a LUXEON Z LED that produces 150 lumens of flux, the calculations are as follows:

On-axis intensity = (39 cd/lm) x (150 lumens) =5850 candela on-axis intensity (one LED).

If 12 LEDs are used in a fixture, then the on-axis intensity = 12 LEDs x 5850 candela/LED
= 70200 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 70200 candela. If that fixture is illuminating a surface one meter distant, then the *illuminance* on that surface is 70200 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 70200 lux/ $(2m)^2$ or 17550 lux. Moving the fixture three meters from the surface decreases the illuminance to 70200 lux/$(3m)^2$ or 7800 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 6° and an on-axis intensity of 70200 cd, then at ± 3° (half of 6°) the intensity will drop to half of 70200 or 35100 cd. If the Field Angle for the fixture is 12°, then at ± 6° (half of 12°) the intensity should be 10% of 70200 or 7020 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

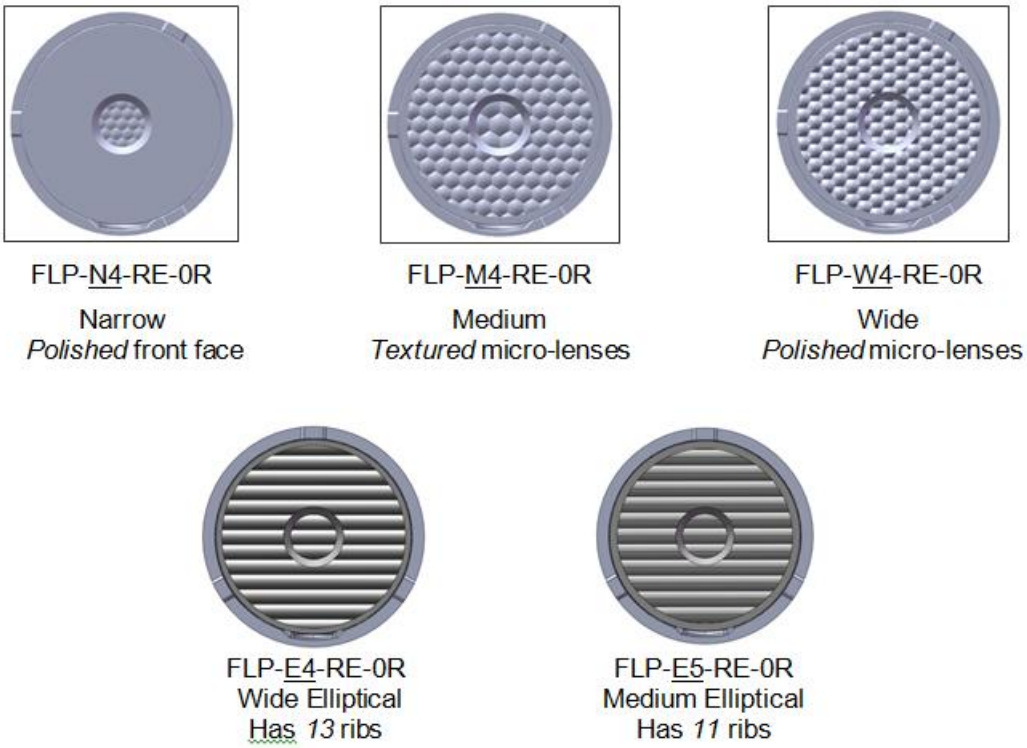
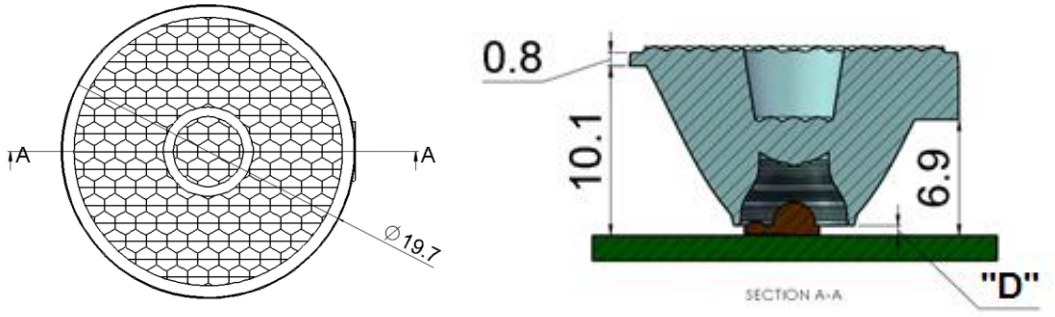


Figure 1. Identifying the FLP series lenses by their front appearance.

The FLP 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 following LEDs: LUXEON R, LUXEON A, LUXEON Rebel, LUXEON Rebel ES, LUXEON Rebel Plus. Orientation control is important for the elliptical beam lens.

NOTE: The holder positions the optic such that the dimension, "D" shown in figure 2 is equal to .6 mm. If the FLP lens is used without a lens holder, the user must provide a mechanical method to set the correct position of the lens relative to the LED. The dimension, "D" required for best performance for each LED is shown in table 1.



All dimensions in millimeters, tolerances ±0.2mm

Figure 2: FLP lens views showing dimensions and correct lens position relative to PCB

Design Considerations

The elliptical lens produces a beam shape that is perpendicular to the ribbing 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.

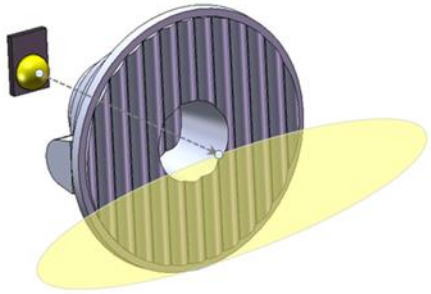


Figure 3: Elliptical beam orientation

The FLP assemblies (lenses in a holder) will fit onto the LUXEON LED at only one orientation. The opening in the bottom of the assembly controls the relationship between the LED body, the attachment screw holes and the lens body. This relationship is especially important when attaching assemblies to boards with screws or when using elliptical beam lenses.

(**NOTE**: The FLP assembly is centered on the emitting dome of the LED, *not* on the center of the LED package. This is an important layout consideration if using screws to attach the assembly to the PCB.)

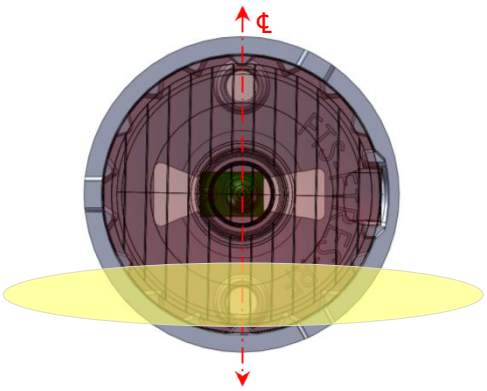


Figure 4: Mechanical features to consider in layout and design

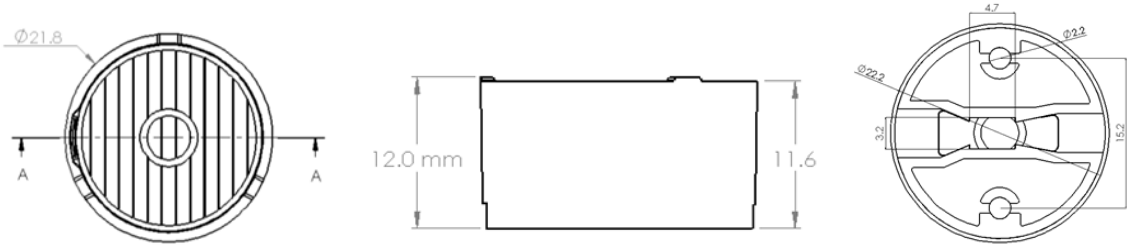


Figure 5: Top, side and bottom assembly views with dimensions

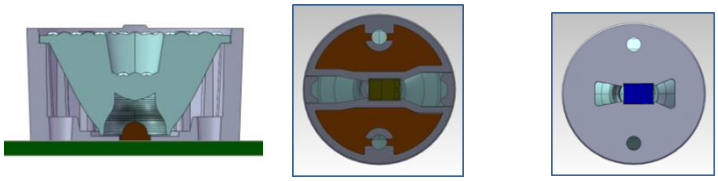


Figure 6: Assembly installation; Tape and Glue attachment options
(Left) Cross section showing FLP assembly correctly installed and in contact with the PCB.
(Right) FLP-__-RS-HRF (right) showing tape surfaces (grey)

Ordering Part Numbers

For lens only (no holder)

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

FLP-_4-RE-0R

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

FLP-E_-RE-0R

4: 13° x 45° Wide Elliptical (LUXEON A White, other colors may vary)
5: 13° x 28° Medium Elliptical (LUXEON A White, other colors may vary)

Caution: The orientation of the elliptical beam lens is determined by the lens position (rotation). See Figs. 3 & 4.

For FLP assemblies (lens + holder)

FLP-_4-RS-HRF	(Black)
FLP-_4-RS-HRFW	(White Holder)
FLP-_4-RS-HRFT	(Transparent Holder)

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

FLP-E_-RS-HRF	(Black Holder)
FLP-E_-RS-HRFW	(White Holder)
FLP-E_-RS-HRFT	(Transparent Holder)

4: 13° x 45° Wide Elliptical (LUXEON A White, other colors may vary)
5: 13° x 28° Medium Elliptical (LUXEON A White, other colors may vary)

Caution: The orientation of the elliptical beam lens is determined by the lens position (rotation). See Figs. 3 & 4.

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