FLP Lens Series
for Philips Lumileds LUXEON™ LEDs

- **High efficiency**
- **Available in 5 different beams**
- **Easy assembly**

The FLP lens series offers five lenses specifically designed for the Philips Lumileds LUXEON A, LUXEON R, Rebel, Rebel ES and Rebel Plus LED[1]s.

The software-optimized aspheric profile combined with shaped front surfaces and micro-lenses provides several different output patterns: narrow, medium, wide, medium elliptical and wide elliptical beams[2].

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

Lens in holders are available to provide the proper alignment between the LEDs and the lenses.

The lens holder can be secured to the PCB using screws, glue or tape for attachment.

Typical applications are:

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

(1) LUXEON, Rebel, Rebel ES and Rebel Plus are trademarks of Philips Lumileds. For technical specification on LEDs please refer to the LUXEON datasheets or visit www.philipslumileds.com

(2) Typical beam divergence may vary with LED color or binning.

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General Characteristics

Materials

Lens Material	Optical Grade PMMA
Holder Material	Polycarbonate: Black
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 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 FLP series for Philips LUXEON Rebel class (Rebel form factor) LEDs.

FLP Lenses

• 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

FLP assemblies

Lens in Black Holder	Lens in White Holder	Lens in 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[1] – On-axis Intensity[2], Beam Angle[3], Field Angle[4]

LED	Beam Shape	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)
LUXEON A White	Narrow	12.5 cd/lm	13°	25°
	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°
	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°
	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°
	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°
	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°

(1) Typical performance. Optical characteristics may change with LED color, color temperature and binning
(2) 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 “Illumination 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.
(3) FWHM is the full angle where the beam intensity is half the on-axis peak intensity
(4) 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.

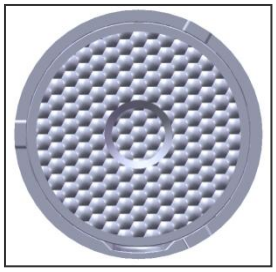
If the lenses in our example fixture, above, have a Beam Angle of 10° and an on-axis intensity of 26460 cd, then at ± 5° (half of 10°) the intensity will drop to half of 26460 or 13230 cd. If the Field Angle for the fixture is 19°, then at ± 9.5° (half of 19°) the intensity should be 10% of 26460 or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

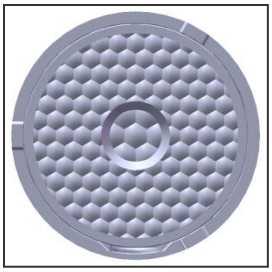
Intensity, illuminance, Beam and Field Angle are all important factors to be considered in a fixture design. Some applications may require specific ratios between the Beam and Field Angle values.

Mechanical Characteristics

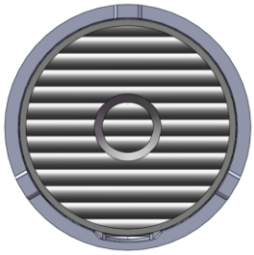
FLP-N4-RE-0R



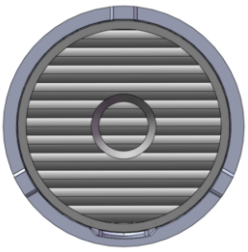
FLP-W4-RE-0R
Micro lenses are polished



FLP-M4-RE-0R
Micro lenses are textured



FLP-E4-RE-0R
Lens has 13 ridges

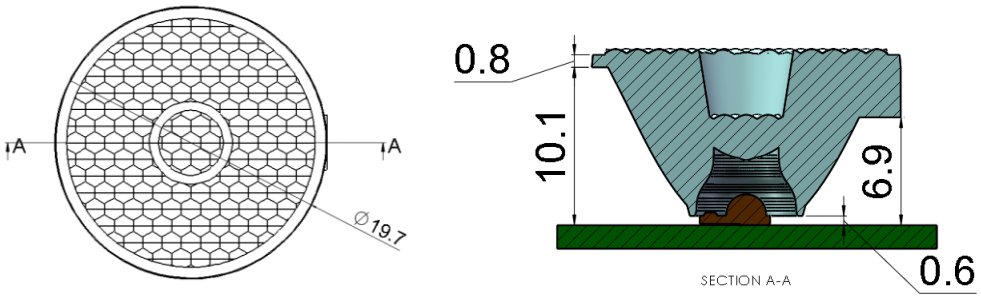


FLP-E5-RE-0R
Lens has 11 ridges

Figure 1: Identifying the lenses by their front views

The FLP series lenses are available assembled with a holder or as a lens alone. 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 FLP 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 dome and establish 10.1 mm from the lens flange to the user's PC board. When the lens is positioned correctly, the bottom of the lens is the same height as the top of the LED rectangle substrate, and concentric with the LED dome lens, as shown below.



All dimensions in millimeters, tolerances ±0.2mm

Figure 2: FLP lens views showing general dimensions and correct lens position above PCB

Design Considerations

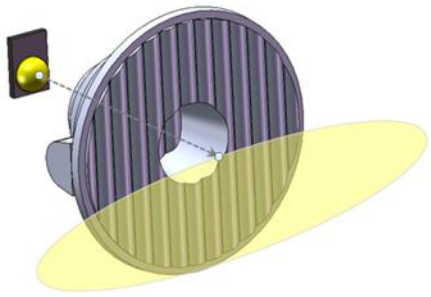


Figure 3: Elliptical beam orientation

NOTE: 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.

Please see the next section for additional layout information.

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.)

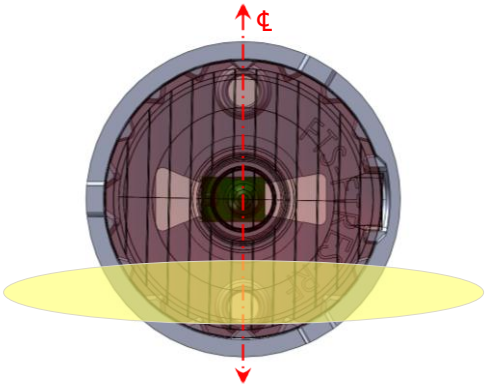


Figure 4: Mechanical features to consider in layout and design

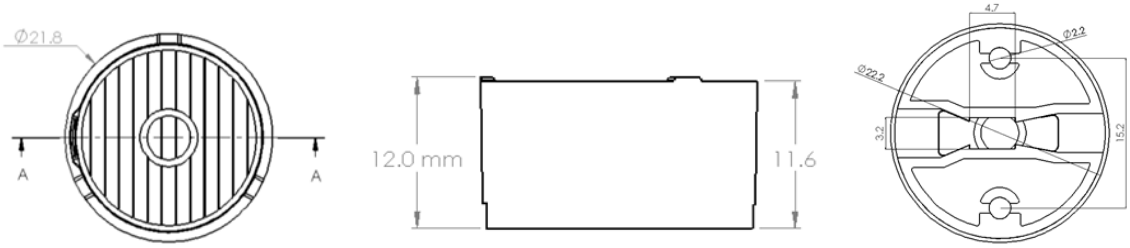


Figure 5: Top, side and bottom assembly views with dimensions

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 Holder)
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 controlled by the lens holder and the LED orientation (see Figs. 3 & 4).