Dual-Beam Focus Optical System (FOCOS™) for Cree XLamp™ LEDs

FXGR-N3-XP1-0R & FXGR-W3-XP1-0R

- **Patented Fraen Technology**
  U.S. Patent #8,118,451
- **Produces Narrow and Wide Beam Patterns**
- **Compact size**
- **High efficiency Designed for use with Cree XLamp LEDs (XP-E, XP-C, XP-G, XM-L, XM-L2)[1]**
  (Please contact Fraen for suitability of this reflector pair with other LEDs)

Fraen's **FOCOS** (**FOC**us **O**ptical **S**ystem) dual beam system consists of two reflectors that work together to deliver both a narrow spot and a wide flood from a single lighting fixture.

The secret behind the **FOCOS** system is its two reflector, two position design. When the outer reflector is extended away from the LED source, the system delivers a tightly focused beam with excellent throw and maximum projection of light.

For tasks requiring smooth, wide beam lighting, simply move the outer reflector to the retracted position, allowing the inner **FOCOS** reflector to deliver a pleasing and uniform area flood.

Typical **FOCOS** applications are ones requiring dual beam patterns, such as:

- Flashlights
- Bicycle lights
- Mining lights and head lights
- Any application requiring quick changes between flood and spot patterns

(1) XLamp and XP-E, XP-C, XP-G, XM-L and XM-L2 are trademarks of Cree, Inc. For technical specification on Cree XLamp LEDs, please refer to the Cree website (www.cree.com/products/ledlamps.asp).

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General Characteristics

Materials

Reflector Material	Black Polycarbonate with vacuum aluminum coating, protected by clear coat lacquer.
Operating Temperature range	-40° C / + 95° C
Storage Temperature range	-40° C / + 95°C

Please note that small defects in the reflective coating, and flow lines and weld lines on the surfaces of the reflectors are acceptable if the optical performance of the reflector is within the specification described in the section "OPTICAL CHARACTERISTICS"

IMPORTANT NOTE – Reflector handling and cleaning*:*

- *Handling: Always handle the reflectors by the outside surfaces or flange. Never touch the inside surfaces of the reflector with fingers; finger oils and contamination will absorb or refract light.*
- *Cleaning: Clean reflectors only if necessary. Use only soap and water to clean the surfaces and reflectors. Never expose the reflectors to alcohol, as it will damage the plastic.*

Scope

This datasheet provides information about the FXGR Dual Beam Focusable System.
(**FXGR-N3-XP1-0R** and **FXGR-W3-XP1-0R** reflector pair)

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

LED	Beam Shape	On-axis Intensity (candela/lumen)	Beam Angle (FWHM)	Field Angle (FW10%)	"L" (mm) see Figure 1
XP-E Cool White	Narrow Wide	31.9 2.3	4° 34°	9° 66°	19.1
XP-E Warm White	Narrow Wide	19.6 2.4	5° 33°	21° 62°	19.1
XP-C White	Narrow Wide	39.2 2.6	3° 32°	6° 64°	19.1
XP-G Cool White	Narrow Wide	19.5 1.7	5° 39°	11° 67°	19.1
XP-G Warm White	Narrow Wide	19.8 1.7	5° 39°	10° 68°	19.1
XM-L and XM-L2 Cool White	Narrow Wide	8.9 1.2	8° 50°	42° 76°	19.7

(1) To calculate the on-axis intensity (cd), multiply the on-axis value, above, of the reflector (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.
(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 reflector 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 reflector 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 reflector. 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 reflectors 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.

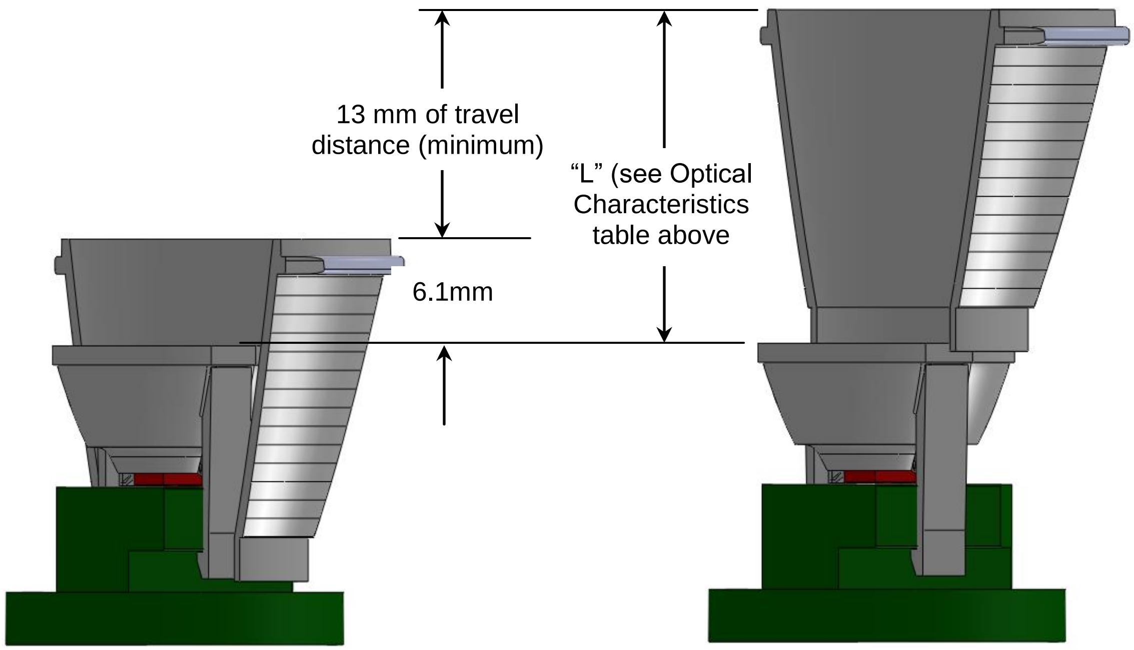
Most reflectors have Beam and Field Angles that are rotationally symmetrical about the center axis of the reflector. Reflectors with an elliptical beam profile or optics with specifically shaped beam profiles are the exception.

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

The FXGR Dual-Beam Focusable Reflector System consists of a narrow (FXGR-N3-XP1-0R) and wide (FXGR-W3-XP1-0R) reflector pair. When in the extended position (see figure 1), the two reflectors work in tandem to product a narrow illumination beam with sharp cut-off of the spill beam.

When the large reflector is in the retracted position, the FXGR delivers a smooth, wide beam illumination.



FXGR in Wide Flood position with larger reflector fully retracted

FXGR in Narrow Spot position with larger reflector fully extended

Extending the large reflector by 13 mm changes the illumination pattern from wide flood beam to narrow spot beam. The heat-sink/pedestal (in green) and the LED (in red) are shown for illustration purposes only and are not provided by Fraen Corporation.

Figure 1. Relative positions of the FXGR-N3-XP1-0R Narrow reflector for producing wide flood and narrow spot beams.

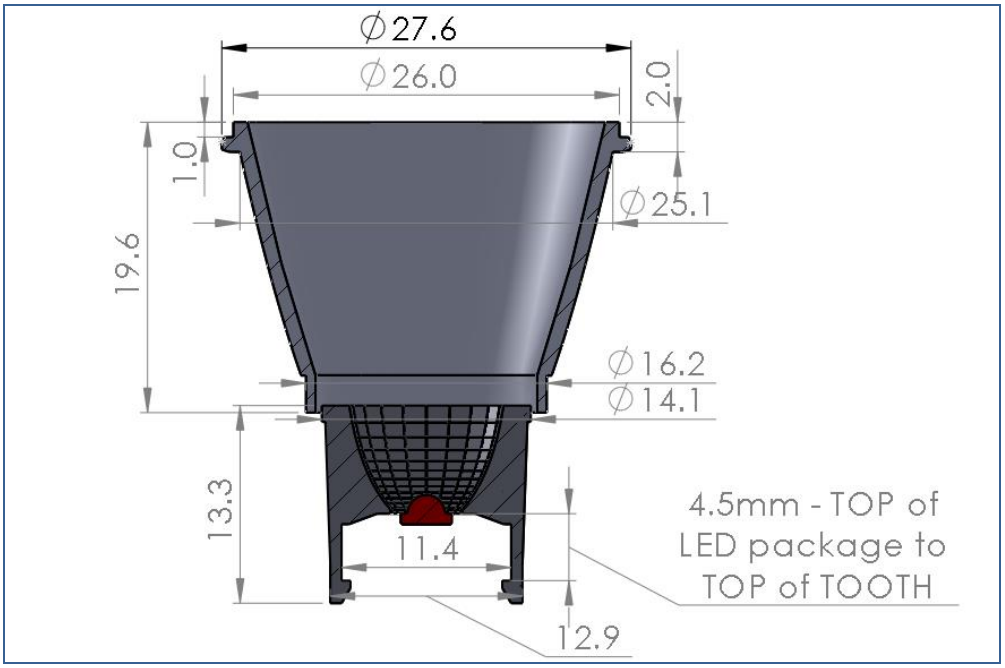


Figure 2. Mechanical dimensions of the FXGR Dual-Beam Focusable Reflector System

Changing the illumination pattern from a narrow to a wide beam requires that the large reflector be moved relative to the LED. The large reflector is designed with a mounting flange, allowing the designer to properly align, secure and move the reflector in their assembly.

The smaller reflector is designed for a snap fit onto the customer's heatsink or PCB. The dimensions of your heatsink will be determined by the LED used. Maximum reflector performance is realized when the top of the LED package is coincident with the bottom of the small reflector, as shown in Figure 2.

To permit full retraction of the large reflector, the LED must be mounted on a heat-sink/pedestal feature (Figure 1 in green). Proper design of your heat sink to accommodate the full retraction of the large reflector and the snap fit of the small reflector is an important design consideration.

Ordering Part Numbers

FXGR-N3-XP1-0R (Large, narrow spot reflector)
FXGR-W3-XP1-0R (Small, wide flood reflector)

These parts must be ordered as reflector pairs to achieve dual beam performance. While the reflectors may be used individually, their performance in this configuration has not been fully evaluated.