FNP Lens series
for Nichia[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 FNP lens offers low-profile lenses specifically designed for compatibility with LEDs from Nichia Corporation.

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

The high collection efficiency typically reaches up to 85% of the total flux emitted by the LEDs.

Lens holders are available in black 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

(1) For technical information about Nichia LEDs please refer to the Nichia Power LEDs datasheet web-link: http://www.nichia.com/product/led-smd-powerled.html

(2) Typical beam divergence varies with LED type and color.

FRAEN CORPORATION
80 Newcrossing Road
Reading, MA 01867
USA
Phone:+1.781.205.5300
Fax: +1.781.942.2426

Inquiries: optics@fraen.com
Website: www.fraen.com

For ordering or sales information in your region, please contact us at the office above or visit http://www.fraen.com/optics/contact-us/.

General Characteristics

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 – 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 and lenses. Never expose the lenses to solvents such as alcohol, as it will damage the plastic.*

Scope

This datasheet provides information about

FNP series lenses:

- FNP-N1-N083-0R
- FNP-N2-N083-0R
- FNP-M1-N083-0R
- FNP-W1-N083-0R
- FNP-E1-N083-0R

FNP series lens assemblies:

- FNP-N1-N083-HRF
- FNP-N2-N083-HRF
- FNP-M1-N083-HRF
- FNP-W1-N083-HRF
- FNP-E1-N083-HRF

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%)
NS6 X083	Narrow	5.9	19°	38°
	Narrow Spot	10.7	11°	30°
	Medium	3.5	25°	46°
	Wide	1.8	39°	56°
	Elliptical	3.3	17° x 39°	37° x 57°
NS6x183	Narrow	5.6	19°	44°
	Narrow Spot	9.6	12°	32°
	Medium	3.4	26°	52
	Wide	1.8	41°	67°
	Elliptical	3.2	18° x 44°	44° x 70°

(3) 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.
(1) FWHM is the full angle where the beam intensity is half the on-axis peak intensity.
(2) Field angle is the full angle where the beam intensity is 10% of the on-axis peak intensity.

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 10.7 candela per lumen (cd/lm) is used with an LED that produces 90 lumens of flux, the calculations are as follows:

On-axis intensity = (10.7 cd/lm) x (90 lumens) = 963 candela on-axis intensity (one LED).

If 12 LEDs are used in a fixture, then the on-axis intensity = 12 LEDs x 963 candela/LED
= 11556 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 11556 candela. If that fixture is illuminating a surface one meter distant, then the *illuminance* on that surface is 11556 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 11556 lux/ $(2m)^2$ or 2889 lux. Moving the fixture three meters from the surface decreases the illuminance to 11556 lux/$(3m)^2$ or 1284 lux.

Beam and Field Angles

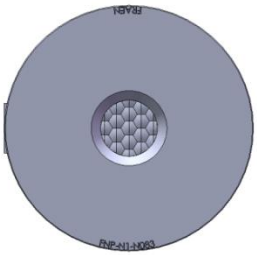
Beam and Field Angles are methods of describing the light distribution of a lens. The Beam Angle is expressed as a FWHM value (Full angular Width of the beam where it reaches Half the Maximum intensity). The Field Angle is a similar concept, sometimes expressed as FW10%, and represents the Full Width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

If the lenses in our example fixture, above, have a Beam Angle of 11° and an on-axis intensity of 11556 cd, then at ± 5.5° (half of 11°) the intensity will drop to half of 11556 or 5778 cd. If the Field Angle for the fixture is 30°, then at ± 15° (half of 30°) the intensity should be 10% of 11556 or 1155.6 cd.

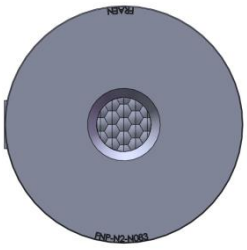
Most lenses have Beam and Field Angles that are rotationally symmetrical about the center axis of the lens. Lenses with an elliptical beam profile or optics with specifically shaped beam profiles are an exception.

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.

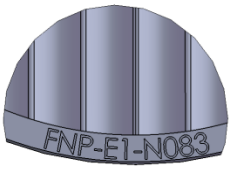
Mechanical Characteristics



FNP-N1-N083-0R
Lens has a *textured* front surface



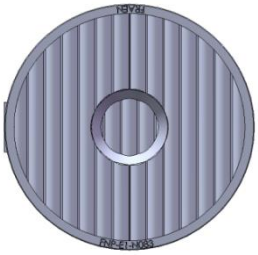
FNP-N2-N083-0R
Lens has a *polished* front surface



All lenses have their part number on the lens flange

FNP-M1-N083-0R
Lens has *lightly textured* micro lenses on front surface

FNP-W1-N083-0R
Lens has *polished* micro lenses on front surface



FNP-E1-N083-0R
Lens has *ribbed* micro lenses on front surface

Figure 1. Identifying the lenses by their front views

The FNP series lenses are available as an assembly with a holder or as a lens alone, 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 FNP 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 10.8 mm from the lens flange to the user's PC board. When the lens is positioned correctly, the bottom of the lens touches the LED.

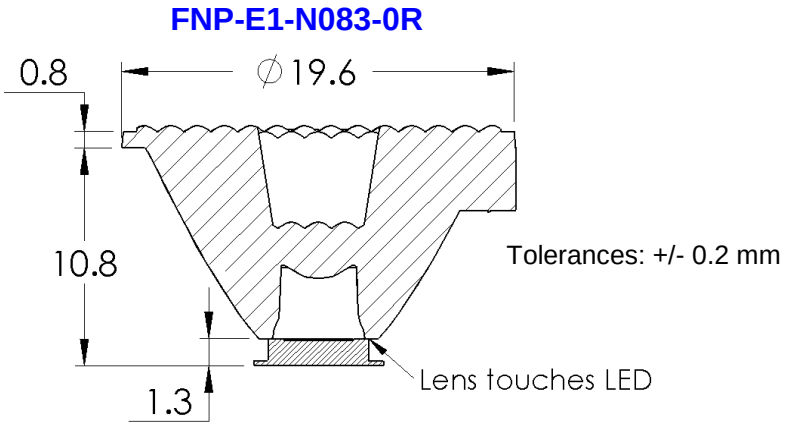
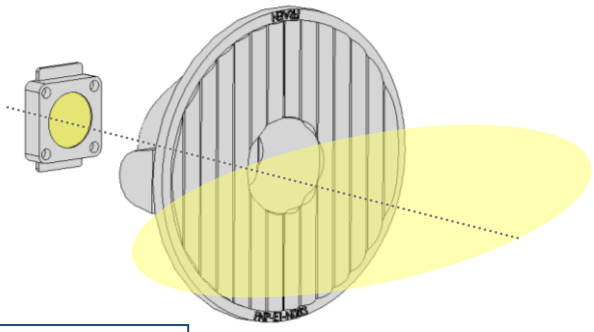


Figure 2. Correct vertical position of the FNP lens and NS6x083/183 LED



The LED contacts and micro-lens ribs are *vertical*.

The elliptical beam and lens gate are *horizontal*.

NOTE: The FNP-E1 elliptical beam lens produces a beam shape that is perpendicular to the micro-lens ribs on the output face of the lens. The lens holder is designed to align the elliptical rib pattern with the square shape and contacts of the Nichia LED. 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

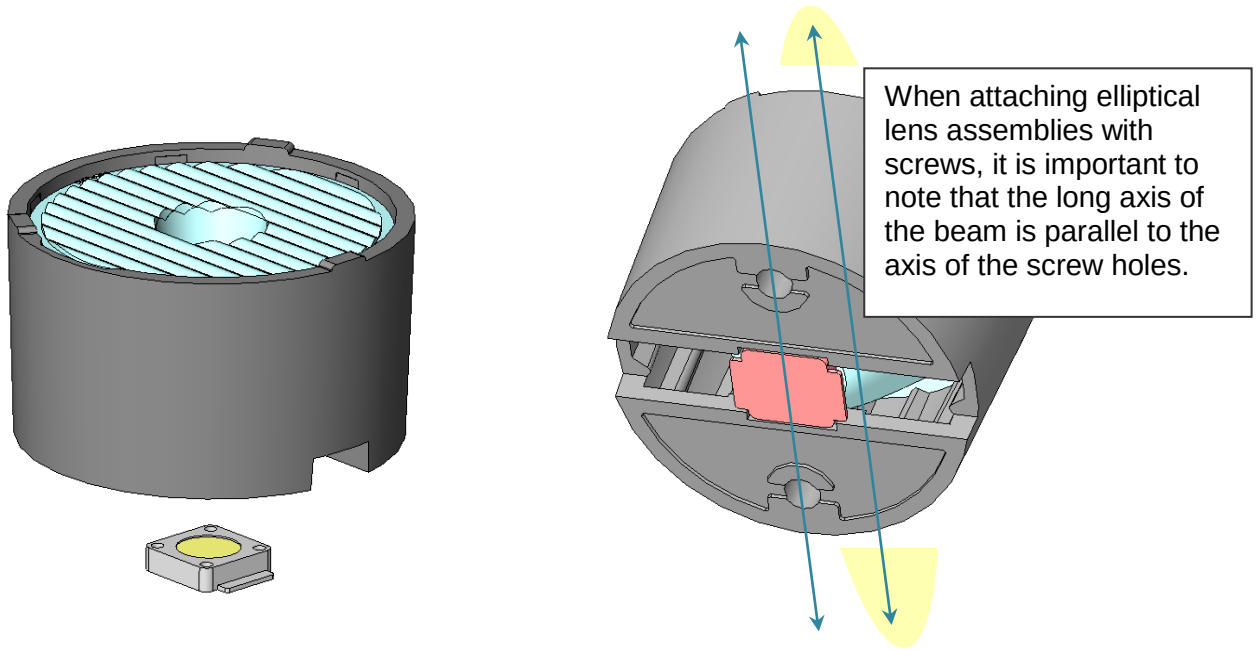
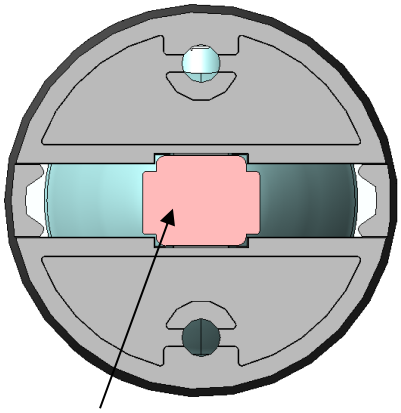
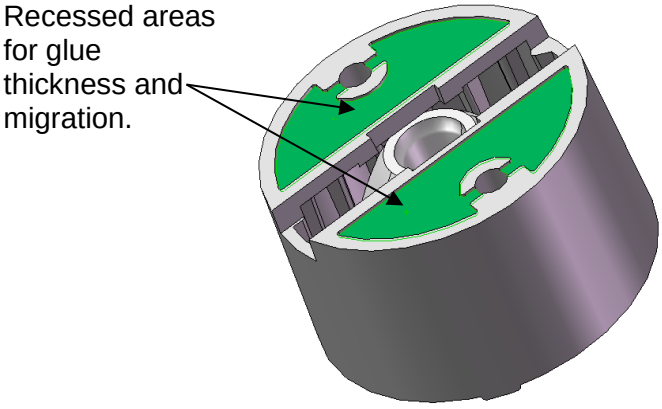


Figure 4. Installation of lens assembly onto Nichia NS6x083/183 LED

The FNP-E2-N083-HRF (and N1, N2, M1 and W1) lens assemblies will fit onto the Nichia NS6x083/183 LEDs at only two orientations: 0 degrees and 180 degrees. The bottom of this –HRF lens holder has a square shape to control lens orientation (important for "E1" elliptical beam lens application). After installation, the bottom of the holder should be at the same datum/plane as the bottom of the Nichia LED.



The LED package will fit into the square hole in the lens holder. This will align the lens to the LED.



The lens assembly can be secured to the PC board by using glue or silicone RTV. 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.

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.

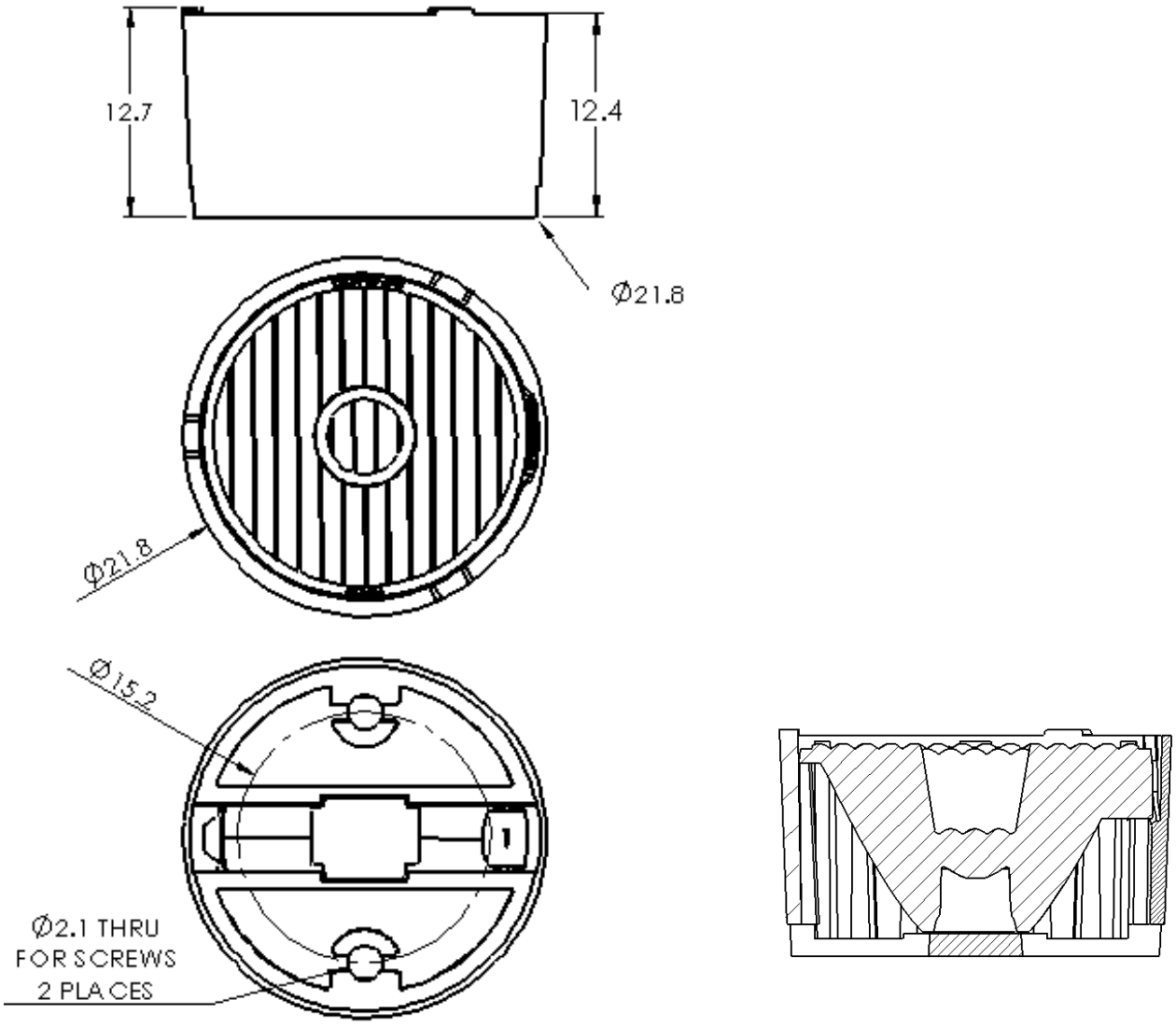


Figure 5. Overall dimensions of FNP-_1-N083-HRF series lens assemblies

Ordering Part Numbers

FNP-__-N083-__

0R: Lens alone (no holder)
HRF: Lens in a black holder

Caution: If using lens alone (without a holder), lens alignment and spacing must be set by the user (see Figure 2).

N1: Narrow Beam
N2: Narrow Spot
M1: Medium Beam
W1: Wide Beam
E1: Elliptical beam

Caution: The orientation of the elliptical beam lens is controlled by the lens holder and the LED orientation (see Figures 3 & 4).

Part Number Examples:

FNP-M1-N083-0R = medium beam lens without lens holder.
FNP-E1-N083-HRF = lens assembly - elliptical beam lens heat-staked into lens holder.

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