Application Note

LLF300 for traffic light type W and type E

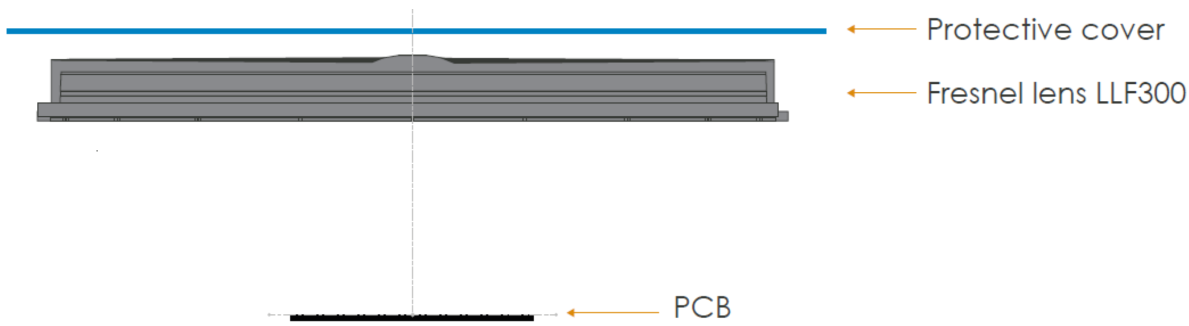
Introduction

To get the desired illumination pattern, the right opto-mechanical configuration of the traffic light has to be defined. The current application note explains how to mount chosen LED with Ø 300 mm Gaggione Fresnel lens PN LLF300, in order to get traffic lights of type W or type E.

Traffic light architecture

A traffic light based on the LLF300 is made of three layers:

- Printed circuit board (PCB) driving a power LED array,
- LLF300 Fresnel lens in PC,
- Protective cover.



The LLF300 is a part of Gaggione Fresnel lenses family adapted to the traffic light market. One side of the element comprises a Fresnel lens, the other side comprises a diffusive surface made of a micro-lenses array. The LLF300 has a clear aperture (optical active surface diameter) of 270 mm, and a focal length of 123.5 mm. The LED have to be placed within the focal plane.

Cover

The purpose of the cover is to protect the internal elements and to shape the beam to the desired angular distribution. **The cover is an integral part of the traffic light**, and is **absolutely necessary** to the right operation of the module. **Without it**, the traffic light is **not operational**.

It is important to note that the **cover is not a standard part**. It has to be customized in order to match the mechanical interface of the existing traffic light.

The cover is typically an **array of micro-lenses**, made of polycarbonate. The micro-lenses can either be defined by their numerical aperture or by their diffusion angle. Please note that **covers containing a diffuser other than a micro-lens array will lead to much reduced performances** (e.g. ground glass, holographic diffuser…).

Choice of LED

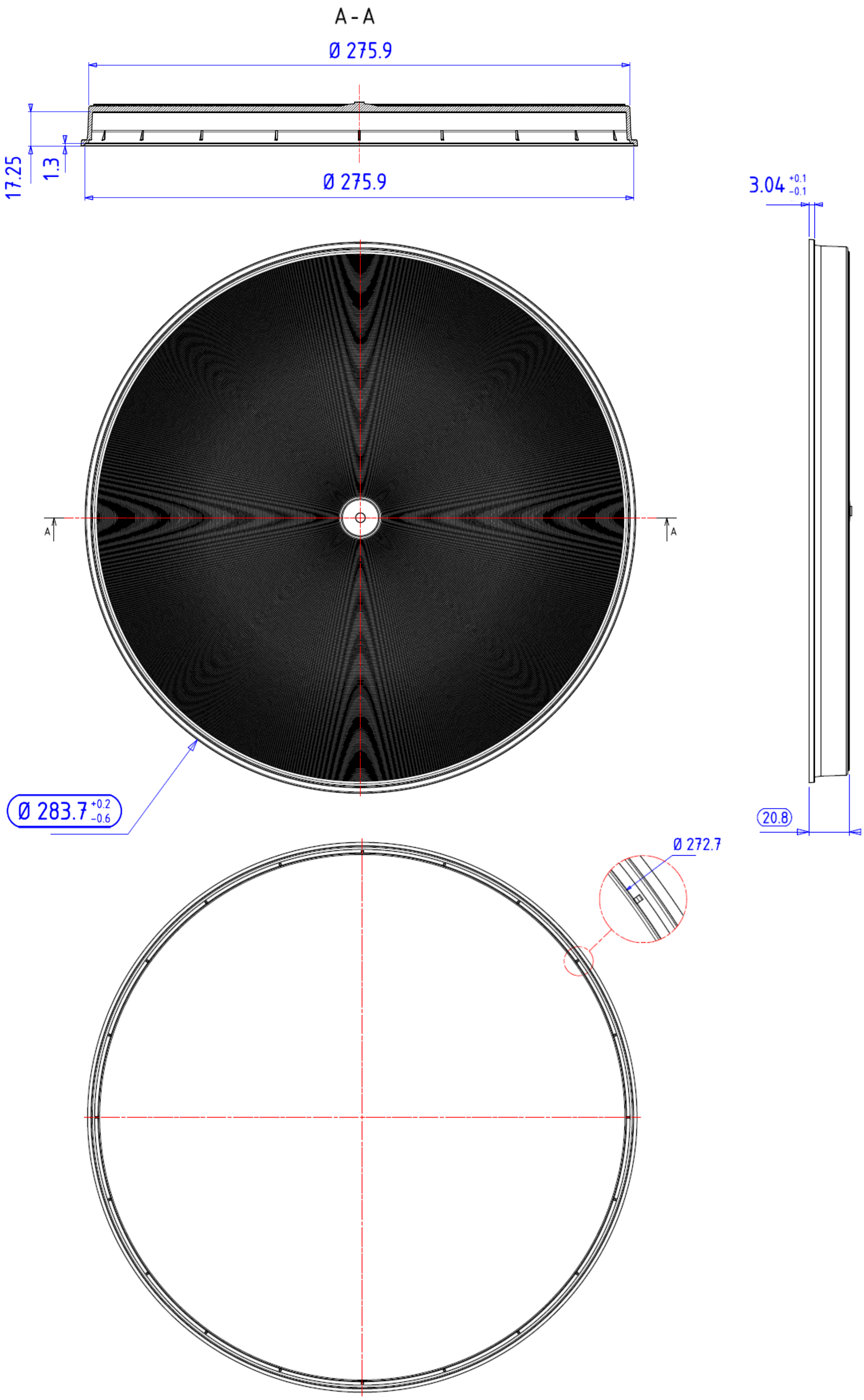
The design shown in this application note was optimized for two types of LED:

- LED with **large emission angle** - 150 deg FWHM
- LED with **lambertian emission angle** - 120 deg FWHM

The main differences between these LED are their intensity profiles and their efficiencies.

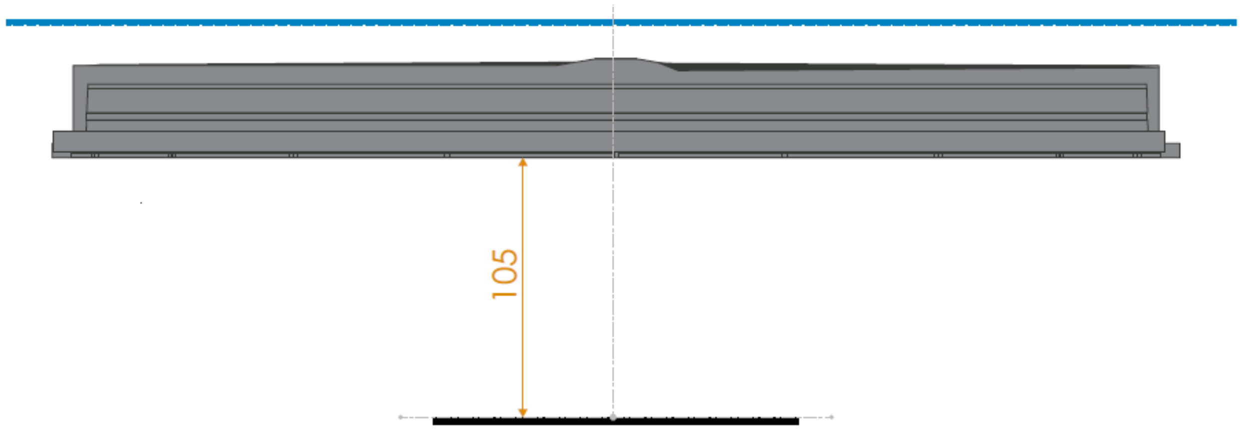
The LED are disposed on a printed circuit board, the emitting surfaces being in the focal plane of the Fresnel lens. The configuration of the LED on the board defines the shape of the output beam. **The same PCB can be used for any of the colors red, yellow or green**.

Plan 2D



General mechanical configuration

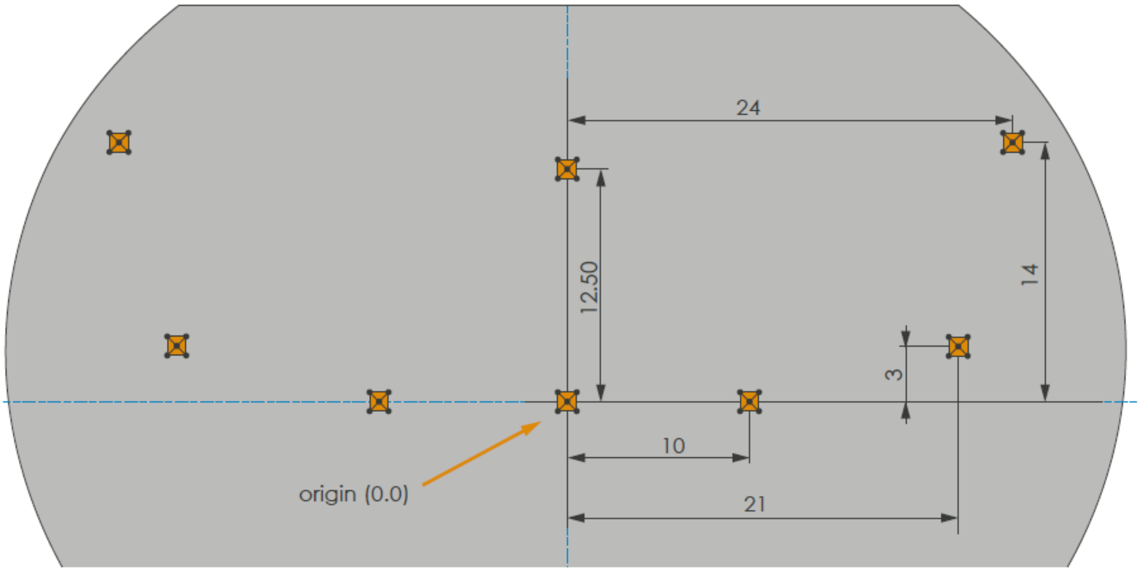
The following drawing explains the general mechanical configuration required for the LLF300, applicable to both types of beams W and E. **The differences between types W and E will be the LED disposition on the PCB and the diffusion angle of the cover**.



- The PCB is placed such that the emitting surfaces of the LED are at the Fresnel lens focal plane, which means 105 mm below its mechanical flange.
- The **cover containing the diffusing surface** has to be placed **as close as possible to the Fresnel lens,** preferably not further than 20 mm from it.
- The **side of the cover** containing the micro-lenses has to be **placed towards the LED**.

Traffic light type W

The following drawing describes the disposition of the LED on the PCB. Eight LED are required to get the desired beam shape. The origin (0,0) corresponds to the mechanical axis of the Fresnel lens, which is also its optical axis. It is noted that the LED are disposed symmetrically right/left, but not top/down because the beam exiting the traffic light is generally oriented downwards.



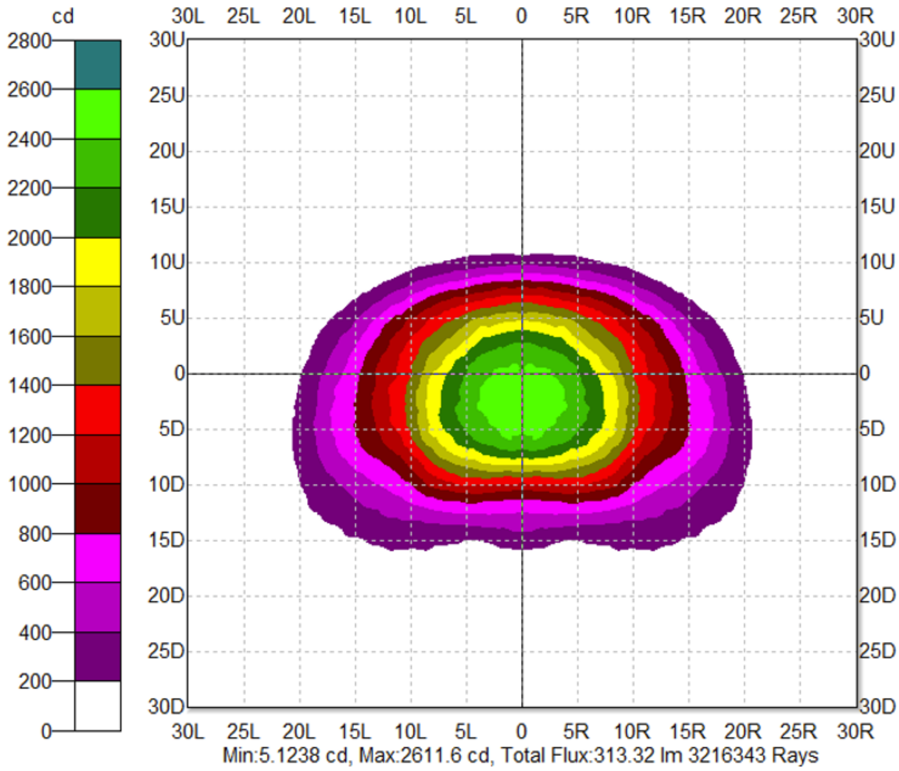
The dimensions refer to the center of the emitting surfaces of the LED.

This LED configuration needs a cover made of micro-lenses having an NA of 0.15, corresponding to a diffusing angle of +/-8.5 deg.

The following performance table shows the LED power required to achieve the desired on-axis intensity:

Required on-axis luminous intensity [cd]	Power per LED required to achieve the required on-axis luminous intensity [lumen]	
	LED with large emission (150°)	LED with lambertian emission (120°)
400	25	20
800	50	35
1 000	60	45
2 000	120	90
2 500	145	110

Here is the intensity diagram for a 1mm² domed LED, at any of the colors, assuming each of the LED emits 100 lumen:



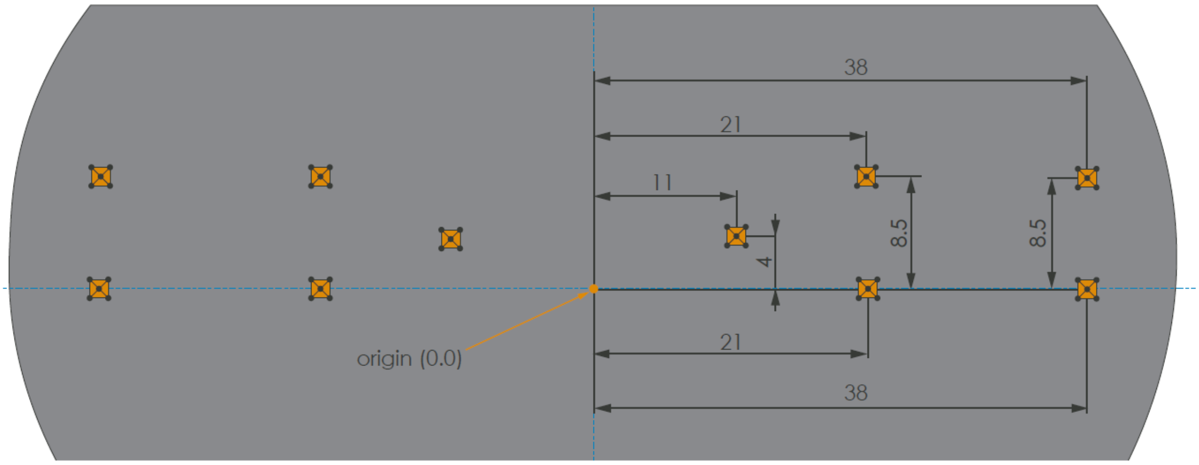
Relative intensity 2D plot

α horiz / α vert - deg	0	+2.5	+5	±10	±15	±20	±30
0	100%	-	93%	60%	-	9%	-
-1.5	-	-	-	-	-	-	-
-3	103%	-	95%	-	-	-	-
-5	100%	-	-	62%	-	-	-
-10	40%	-	-	-	-	10%	-
-20	1%	-	-	-	-	-	-

Relative percentage values for particular angles of interest
According to the norm NF EN 12 368

Traffic light type E

The following drawing shows the disposition of LED are required to get the desired beam shape. The origin (0,0) corresponds to the mechanical axis of the Fresnel lens, which is also its optical axis. It is noted that the LED are disposed symmetrically right/left, but not top/down. Attention has to be brought to the fact that there are no LED disposed below the Fresnel lens optical axis.



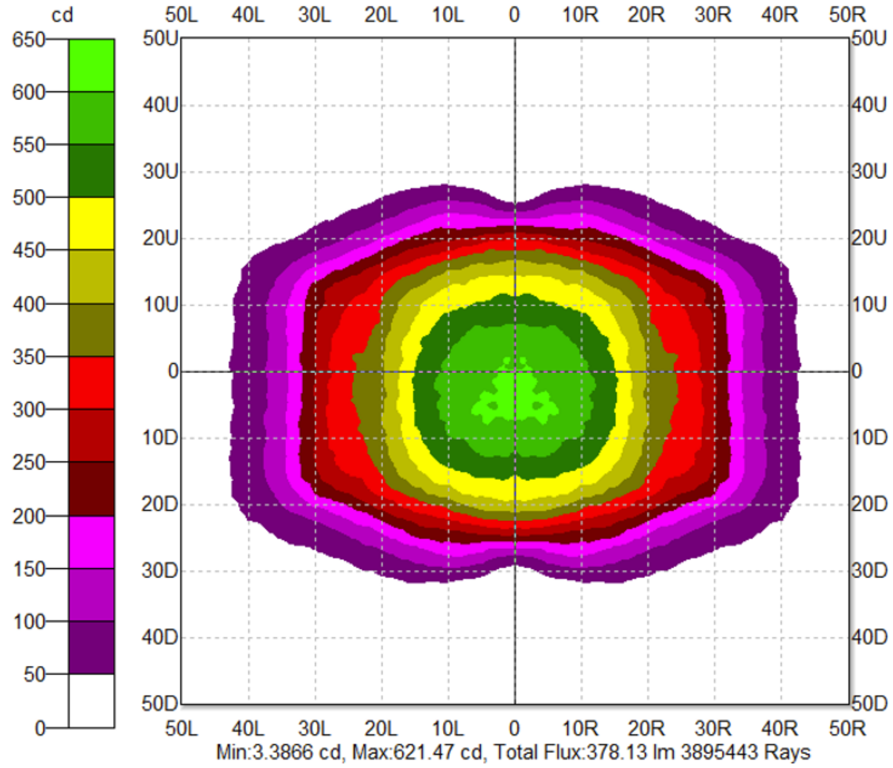
The dimensions refer to the center of the emitting surfaces of the LED.

This LED configuration needs a cover made of micro-lenses having an NA of 0.34, corresponding to a diffusing angle of +/-20 deg.

The following performance table shows the LED power required to achieve the desired on-axis intensity:

Required on-axis luminous intensity [cd]	Power per LED required to achieve the required on-axis luminous intensity [lumen]	
	LED with large emission (150°)	LED with lambertian emission (120°)
100	25	20
200	45	35
400	90	70
800	180	140

Here is the intensity diagram for a 1mm² domed LED, at any of the colors, assuming each of the LED emits 100 lumen:



α horiz / α vert – deg	0	+2.5	+5	±10	±15	±20	±30
0	100%	-	98%	93%	-	65%	46%
-1.5	-	-	-	-	-	-	-
-3	102%	-	100%	-	-	-	-
-5	100%	-	-	93%	-	-	-
-10	92%	-	-	-	-	57%	-
-20	70%	-	-	-	-	-	18%

Relative percentage values for particular angles of interest
According to the norm NF EN 12 368

Tolerances

The current design is insensitive to standard mechanical tolerances used in the industry.