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Application Note

ML-25-50 for lighting

Optotune AG | Bernstrasse 388 | CH-8953 Dietikon | Switzerland
Phone +41 58 856 30 00 | www.optotune.com | info@optotune.com

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Introduction

The following application note outlines information about the integration of the ML-25-50 Lumilens into a lighting fixture. It contains several setups with different components as a basis for your own fixture design. With this information, it's a simple process to integrate the ML-25-50 Lumilens into a lighting fixture and to choose the right components for the target performance.

ML-25-50

The ML-25-50 has three clip connectors on the housing for the mounting of the lens on a lighting fixture and a cogwheel for easy motorization (figure 1).

Figure 1: ML-25-50 lens

Specifications

Product	**ML-25-50-NOC-MR**
Dimensions (ø x thickness)	50mm x 19mm
Clear aperture	25mm
Focal length range (EFFL)	From 39mm to infinity
Lens Type	Plano convex
Transmission (visible)	83%
Refractive Index n_D	1.382
Abbe number V_d	71
Operating Temperature	-20°C to +85°C

Product name explanation:

ML: Manually tunable
NOC: No coating
MR: Medium dispersion material

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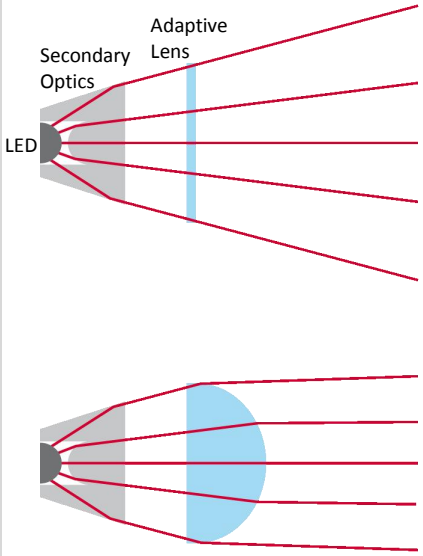
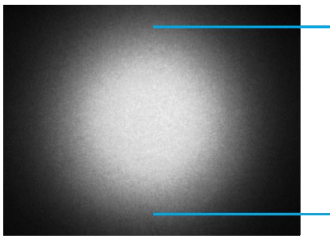
Adaptive Lighting Principle

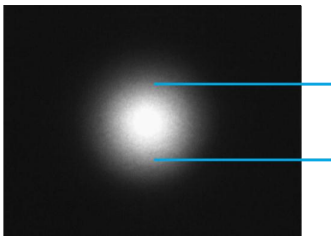
The principle of a light with an adaptive lens is outlined below. The design always includes an LED, secondary optics and the adaptive condenser lens for the tuning of the spotlight. The secondary optics define the maximum angle of the spotlight. Ideally, the secondary optics have a diffuse layer on top, to prevent the image of the LED structure from being projected when the adaptive lens is tuned. The adaptive condenser lens is then added as the tertiary optics. In the plane stage, the adaptive condenser lens just passes the light through, without any deflections. Therefore, the spotlight angle of the secondary optics defines the initial spot size. By tuning the adaptive condenser lens, the spotlight can be focused to the smallest spot size.





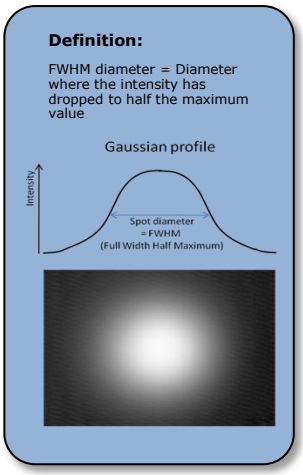
Maximum Angle
(FWHM)

(Angle of the
secondary optics)

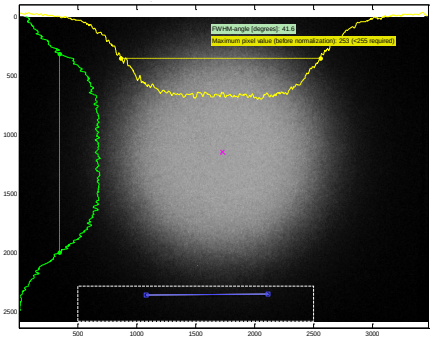


Minimum Angle
(FWHM)

(Adaptive lens
fully tuned)



In order for the adaptive condenser lens to work as efficiently as possible, it is necessary that the light is evenly distributed by the secondary optics. The measurement below illustrates the even distribution. It can generally be said, that a combination of LED and secondary optics with a FWHM (Full Width Half Maximum) angle of 35° or above will have an adequate light intensity distribution. The higher the angle the better is the light intensity distribution, which therefore results in a better tuning result. That's why it can be possible that a larger angle of the LED and secondary optics results in a smaller spot size in the fully tuned state.



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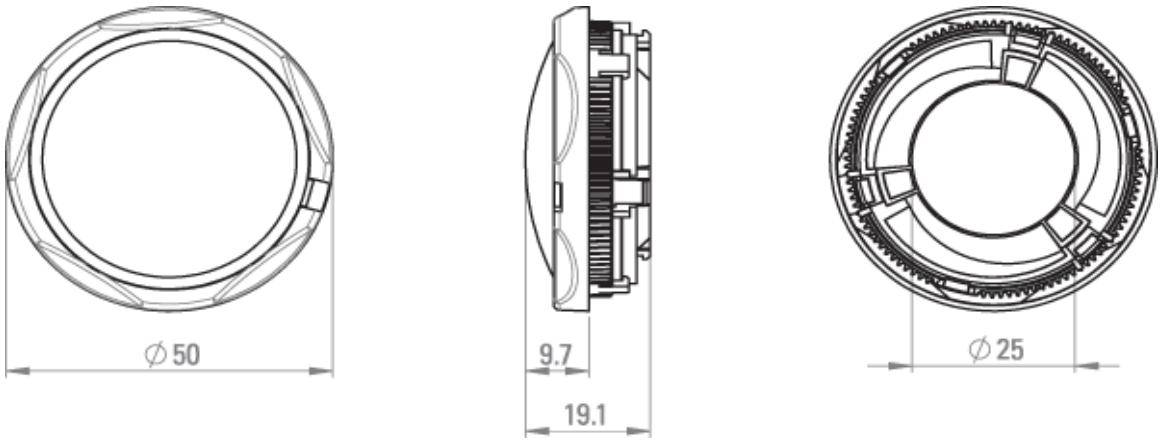
Design & Optics

General

When using a tunable lens in an optics design for an LED lighting fixture, secondary optics should be used to collimate the light from the wide beam of the LED to the desired maximum angle, as outlined in the description of the adaptive lighting principle above. To collimate the LED light, it's recommended to use either **TIR lenses with a frosted top or reflectors with a diffuser**. For the best tuning result, the beam should have an even distribution of the light intensity. Then, by tuning the adaptive lens, the beam can be focused to a small spot size. This moves the focal point of the lens towards the LED board, causing an image of the LED chip to be projected onto the spot. To avoid this effect, diffuse layers have to be used with reflectors or TIR lenses with a frosted top. The distance of the adaptive lens to the LED board largely depends on the angle of the secondary optics. The beam should cover most of the clear aperture at the adaptive lens for the best tuning result and highest efficiency. In the section "Optics" below, several optical design recommendations with different components are suggested.

Design



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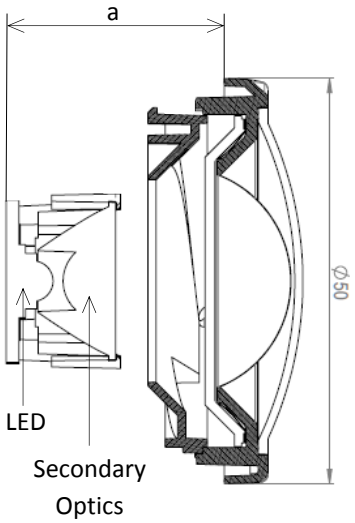
Optics



LED	Max. luminous flux LED (lm)	Secondary Optics	Diffuser*	Distance LED to ML-25-50 (a)	Wide angle (FWHM)	Narrow angle (FWHM)
Cree MC-E	560	Carclo 20mm Frosted Wide TIR lens, Part No. 10196	No	26.9 mm	43°	17°
Cree XR-E	170	Carclo 20mm Frosted Wide TIR lens, Part No. 10202	No	26.9 mm	43°	17°
Cree XM-L	1040	Ledil Boom-W Reflector Part No. CA10931_Boom-W	Yes	28 mm	38°	14°
Lumileds Luxeon M	1200	Dialight 22mm TIR optics Part No. OPC1-1-WIDE	No	24mm	50°	20°
Lumileds Luxeon M	1200	Ledil Boom-W Reflector Part No. CA10931	Yes	27.5mm	43°	14°
Luminus Devices SST-50	1250	Carclo 20mm Frosted Wide TIR lens, Part No. 10202	No	24mm	38°	18°
Luminus Devices SST-50	1250	Ledil Boom-W Reflector Part No. CA10931	Yes	27.5mm	44°	8°

*A holographic diffuser is placed on top of the secondary optics to prevent LED chip image projection. For the above measurements, a 10° (FWHM) holographic, polycarbonate diffuser from Luminit was used www.luminitco.com.

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Interface

Clip connector

The ML-25-50 Lumilens is designed with 3 clip connectors to allow for easy mounting. The CAD files of the ML-25-50 Lumilens and the mounting adapter are available on request.

Motorization

The housing of the ML-25-50 Lumilens has a cogwheel for easy motorization. With a small motor, the lens can be tuned electronically. The cogwheel on the motor needs to be a Pinion M0.4/10 teeth to be compatible with the ML-25-50 Lumilens.

Options

Diffuse container

The ML-25-50 can be produced with a diffuse container glass, allowing it to be used in optical designs incorporating a reflector, without integrating an additional diffusion layer. Minimum order quantity and pricing on request.

Coating

For higher efficiency, the ML-25-50 can be ordered with visible coated components to increase the transmission of the ML-25-50 to around 96-97%. Minimum order quantity and pricing on request.

Color

The standard color of the ML-25-50 Lumilens is black. We can provide the housing in any color. Minimum order quantity and pricing on request.

Core lens element only

It's also possible to purchase the core lens element only and build the housing directly into the fixture design. CAD files of the housing are available on request.

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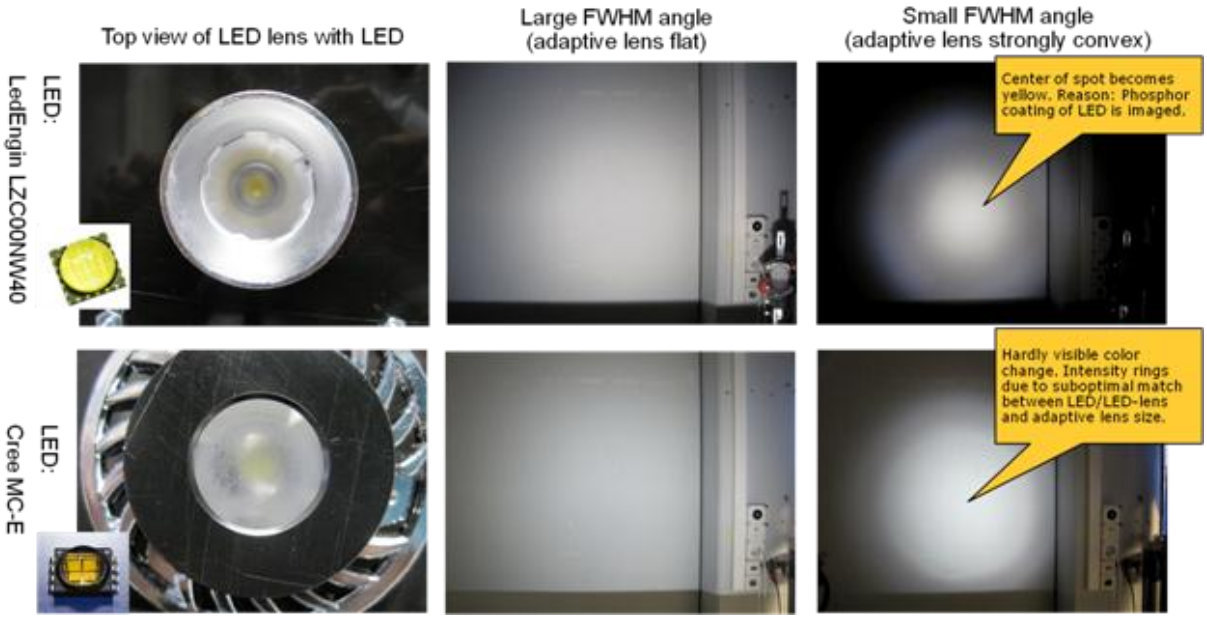
Color transmission

Due to the high Abbe number of the adaptive lens fluid, there are no chromatic aberrations. This could be confirmed in several measurements which showed no color errors at the edge of the spot.

However, if the LED has a large phosphor coating over the whole chip (e.g. LedEngin), the coating can be imaged in the fully tuned state and causes a color error.

With a chip that has only a phosphor coating on the single LED and not the whole chip (e.g. Cree MC-E), the effect was not observed. See the illustration below:



Further Information & Support

For further information about the design of a lighting system with adaptive optics, or a quote to support you in your applications engineering don't hesitate to contact us at sales@optotune.com

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