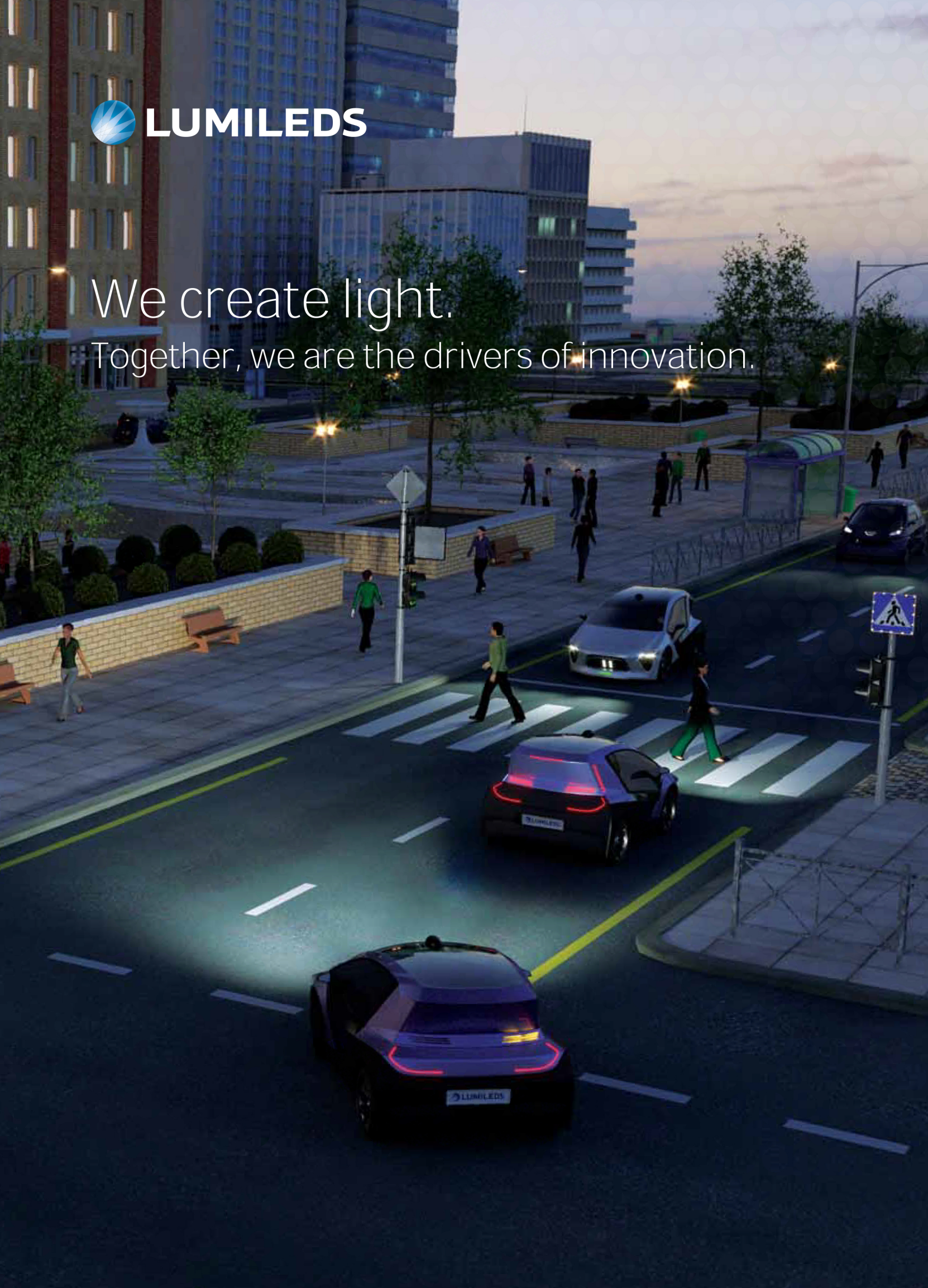




We create light.

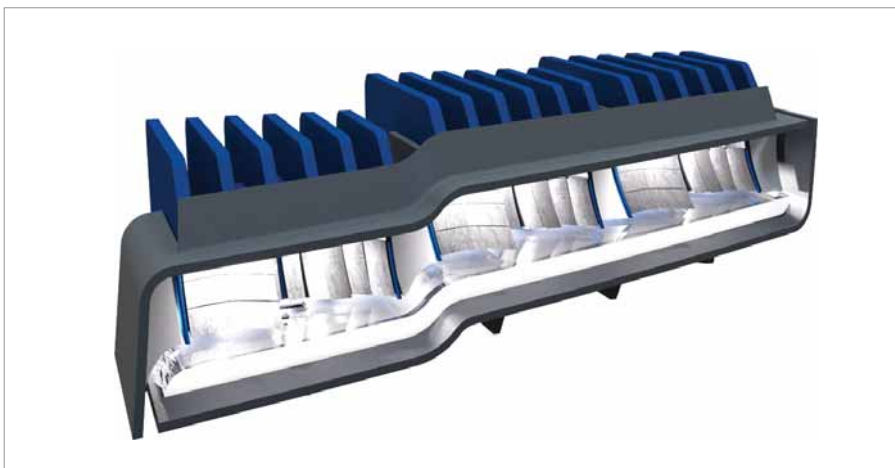
Together, we are the drivers of innovation.





New gems to sparkle up your headlamp design

LUXEON Altilon Intense, LUXEON FX and LUXEON Versat



Lumileds is continuously looking to further enhance its product feature performance, enabling next generation headlamp design.

The new state-of-the-art Lumileds front-lighting portfolio additions are

LUXEON Altilon Intense

LUXEON FX

LUXEON Versat

FEATURES AND BENEFITS

LUXEON Altilon Intense

- Pioneering high luminance, featuring miniaturized die design in multi-chip package proliferations
- Enabling compact optical systems for slim headlamp design and/or superior beam performance

LUXEON FX

- Featuring the latest Lumileds WLP high-power die technology in a robust, high-performance single-chip package
- Complements perfectly the multi-chip LUXEON Altilon SMD family range

LUXEON Versat

- Mid- and high-power signaling devices with industry-standard footprint and robust package design
- Cost-effective solution, enabling high-volume front-signaling market adoption

PRIMARY APPLICATIONS

LUXEON Altilon Intense

- Low/high beam and matrix headlighting

LUXEON FX

- Low/high beam and matrix headlighting
- DRL and turn indicator

LUXEON Versat

- Front signaling functions: DRL, position and turn indicator

Three new product additions to our front-lighting portfolio are shown on our demonstrator

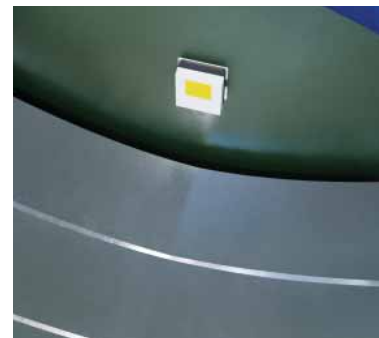
LUXEON Altilon Intense

- To achieve compact and slim optical headlamp design, the high-luminance LUXEON Altilon Intense is used for **low-beam** function on our demonstrator
- Luminance up to 140 Mcd/m²
- Multi-chip SMD packages with 0.5 mm² small, chip-size Light-Emitting Area (LEA) per die
- Improved tolerance levels and contrast to match smaller-size luminaires



LUXEON FX Plus CW

- The **high-beam** function makes use of LUXEON FX Plus CW, comprising our latest WLP die technology in a state-of-the-art, single-die package
- High maximum rating of 1.5A enables the highest possible flux from a single package
- Thermal pad design for best thermal management
- Best-in-class Color-over-Angle (CoA) properties
- Matches perfectly the LUXEON FX Plus PCA product family for dual-function DRL/FT designs, providing the best-in-class luminous flux



LUXEON Versat

- The **DRL solution** uses multiple LUXEON Versat 3030 CW 350 to enable the long and attractive, homogeneous, signature appearance
- The **turn-indicator solution** uses LUXEON Versat 3030 PCA 150 to demonstrate a progressive turn solution, matching also the styling needs arriving with compact headlamps

The LUXEON Versat family provides

- Industrial standard footprint, perfect for high-volume assembly
- Superior thermal management, due to large anode-pad design
- Multiple product family proliferations in white and amber, and also in red, for rear signaling functions



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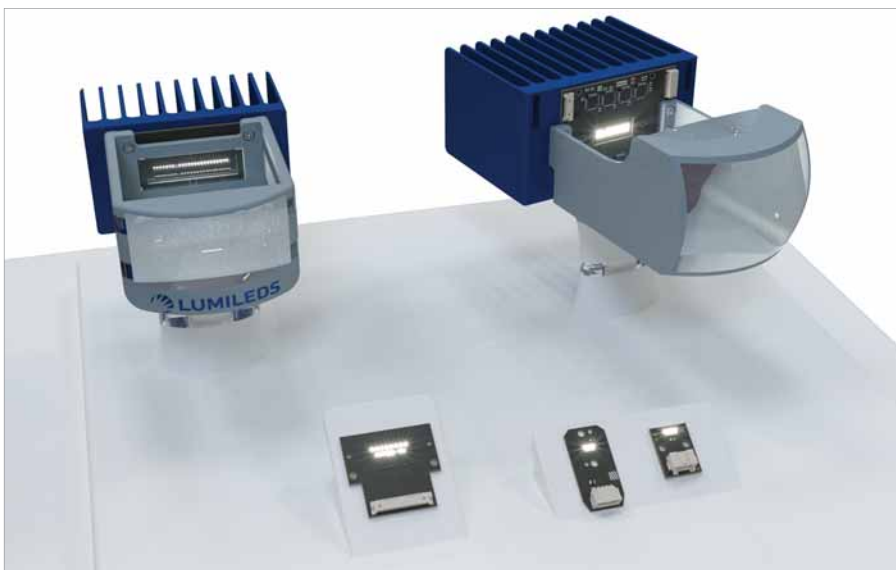
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L2+ customized solutions

for Adaptive Front-lighting Systems
and main-beam applications



We offer a variety of integrated and customized LED L2+ solutions, starting from LUXEON Altilon SMD PnP for simple high-beam or low-beam applications, to full-matrix modules, using the compact-size LUXEON Neo LED with small footprint and best-in-class tolerance. Our turn-key solutions allow for best time-to-market delivery and superior performance and reliability.

FEATURES AND BENEFITS

- Free configuration of LED count, position and size, enables a wide variety of customization options
- LED to LED pitch in X and Y directions as close as 1.25 mm for LUXEON Neo based solutions
- X, Y and Z tolerance superior to 50 μm for LUXEON Neo-based solutions, allows for an increase in optical system performance
- Additional electronics and customized pre-collimating optics may be integrated, as required
- Hassle-free solution with guaranteed performance and reliability

PRIMARY APPLICATIONS

- LED matrix headlighting
- AFS Adaptive Front-lighting Systems
- ADB Adaptive Driving Beam
- Low-beam/high-beam modular solutions

L2+ customized solutions

- Sourcing LED L2+ modules directly from Lumileds guarantees the best possible performance and quality
- Thanks to the latest LED technology used in our solutions, we offer faster time-to-market with reduced development effort for our customers
- A wide variety of solutions and configurations are possible

LUXEON Altilon SMD PnP

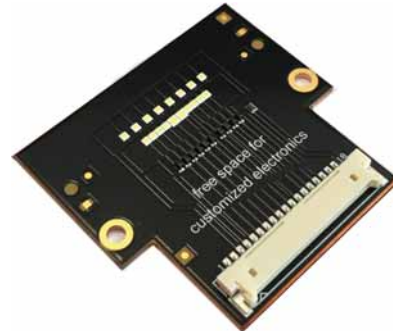
Simple modules for low beam or high beam

- Based on LUXEON Altilon SMD 1x2, 1x4 or 1x5
- Optimized for thermal management and reliability
- Board size, shape, connector and electronic components can be customized, if required



Matrix modules with mixed die sizes, if needed

- Based on 0.5 mm² and 1 mm² dies
- Different board types, sizes and shapes are possible
- Free number of rows and columns (M x N) selection
- Superior positioning accuracy (< 50 µm in X, Y, Z) of LEAs to one another and of LEAs to reference (LEA: Light-Emitting Area)



Optional optics and switching electronics integration

- Complete module solutions, including electronics and primary optics deliver guaranteed performance and reliability
- Reduced development time and effort for our customer



Solutions with very close die spacing

- Enabling solutions without primary optics
- LEA-edge to LEA-edge in X and Y of less than 100 µm will be possible in the future



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LASER-based white light source

High-performance, white light source for high-beam spot application, with fully integrated safety features



Lumileds LASER-based, white light source solution, builds upon a reflective blue LASER light conversion architecture. It features state-of-the-art phosphor technology that delivers white light with excellent color homogeneity and extremely high optical efficiency. Its design architecture allows for high-temperature application and fully embeds the required safety features.

FEATURES AND BENEFITS

- Superior luminance for excellent optical beam efficiency and extended beam range
- Perfect color homogeneity to match the low- and high-beam functions of the main LED headlamp
- Plug-and-Play modular solution offering easy system interfacing
- Our modular architecture fully integrates active and passive safety features for safe handling and use

PRIMARY APPLICATIONS

- Static high-beam spot
- Dynamic high-beam spot

LASER-based white light source

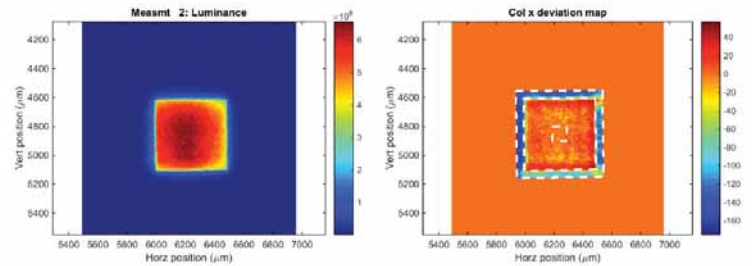
Fully integrated module with clearly defined system interfaces

- Optical
- Thermal
- Mechanical
- Electrical



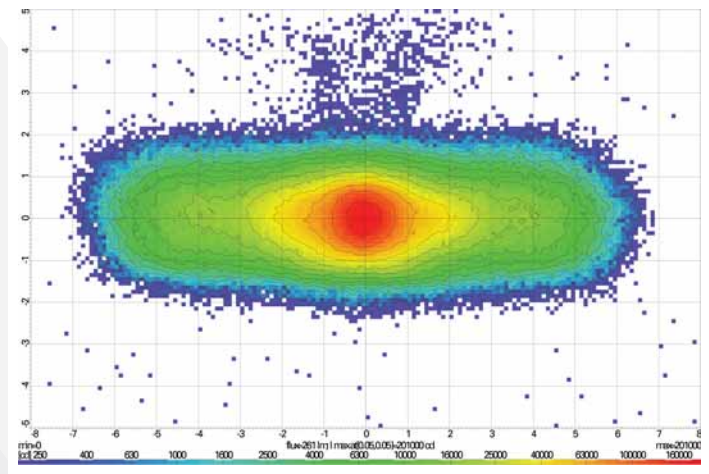
Superior color homogeneity at highest luminance

State-of-the-art phosphors, together with reflective architecture, deliver superior luminance.



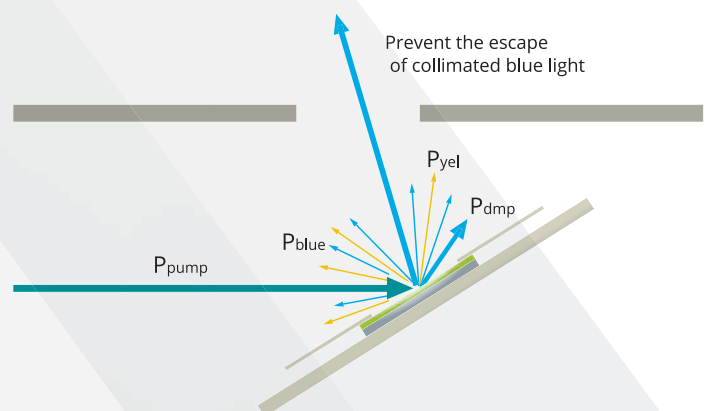
High optical beam performance

With the visibility of more than 600 meters [(1 lx) and $\pm 7^\circ$ width], it offers a comfortable and safe driving experience.



Integrated safety solution

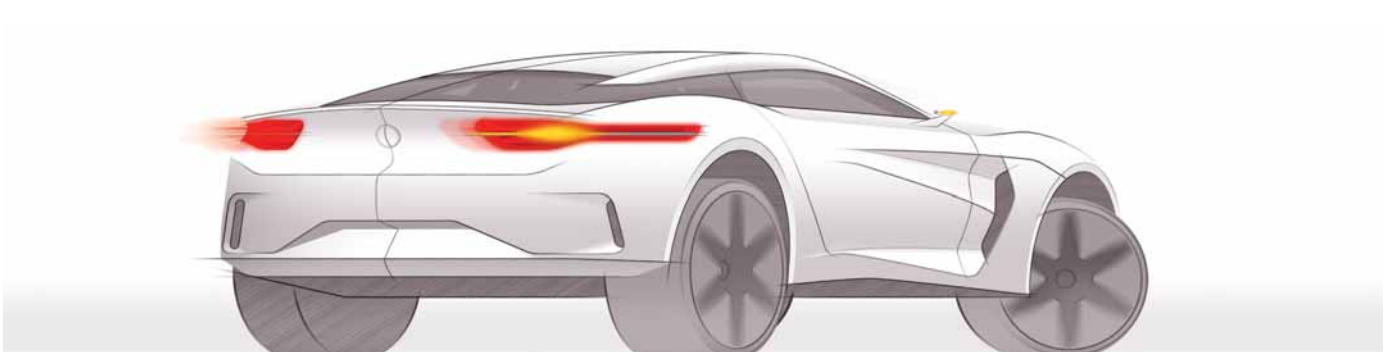
Safety features will be fully embedded and compliant with regulatory standards for LASER safety and developed according to **ISO26262**.



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3D LED

Brings your future styling to life



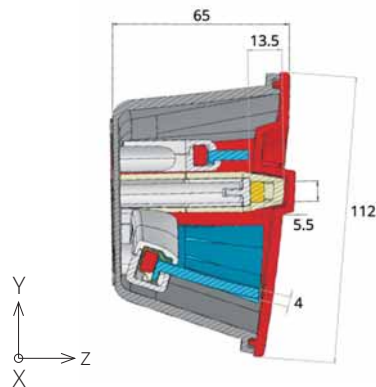
3D LED solutions allow set makers to create OEM's future lighting design wishes in an attractive and cost-effective way, while introducing new differentiation value to styling-driven market segments.

FEATURES AND BENEFITS

- Bi-directional, bendable and compact light source achieves full freestanding 3D sculptures and linear lighting profiles, fitting into previously unreachable areas in a car body
- Rear-signaling color range and integrated optics accommodate all exterior signaling functions
- Embedded optical, thermal and mechanical interface allows for easy handling and assembling

PRIMARY APPLICATIONS

- Signature functions in Super Red, Red Orange and Amber
- Rear turn, tail and stop
- Attractive and uniform elongated CHMSL



3D LED specifications

3D LED is an elongated light source that is bendable in both Y and Z directions and can be twisted in X direction.

Optical

Lambertian profile, Light Emitting Area 4 mm

	Spacial homogeneity	Wavelength (nm)	Pulsed light output (lm/mm)
Tail	90%	615; 635 (RO; SR)	1; 0.5
Stop / tail	50%	615 (RO)	1
Turn	50%	592 (AMBER)	1

Electrical

$V_{\text{frange}} = 7 - 7.3 \text{ V}$, $I_{\text{fnom}} = 70 \text{ mA}$, $I_{\text{fmax}} = 110 \text{ mA}$

Mechanical

Material	Silicone rubber
Outer dimension	8 mm x 5.5 mm
Length segmentation	10 mm
Minimum bending radius (z, y)	25 mm
Minimum twist (x)	90° over 50 mm

Thermal

$T_{\text{amb max}} = 85^\circ\text{C}$, $T_{\text{j max}} = 135^\circ\text{C}$

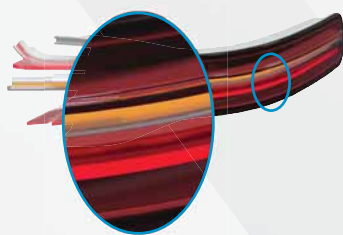
Application design rules

3D LED enables a wide range of styling possibilities in a minimized form factor, with constant interfacing over length.

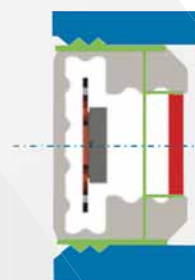
Seamless optical connection

Edge-to-edge mounted 3D LED strips

No dip in light emission visible at edge



Easy mechanical referencing

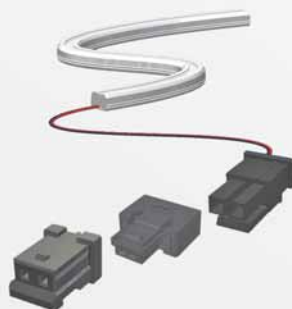


- Light Emitting Area (LEA)
- Reference of LEA to holder
- Detail of holder device



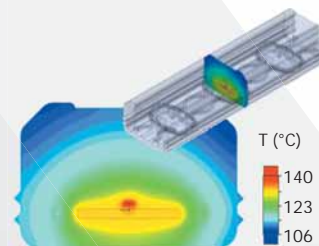
Electrical connection

Cable solution at the end of a 3D LED with various connector options



Thermal conditions

Simulated temperature distribution
 $I = 0.06 \text{ A}$, $P_{\text{th}} = 0.4 \text{ W}$,
 $T_{\text{a max}} = 85^\circ\text{C}$



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LED bulbs and modules

Standardized LED solutions for cost-effective automotive lighting



We offer a large variety of regulated and standardized LED bulbs and modules for automotive lighting applications. Reliable, powerful and yet compact, LUXEON LxN standard modules have the design freedom you need, to meet current styling needs. Our standard interfaces allow for minimal effort in design phase, faster product proliferation and roll-out, with a lower total cost of ownership.

FEATURES AND BENEFITS

- Easy thermal management enables compact luminaire design
- Turnkey solutions with integrated heat sink and driver
- Powerful light from a small source provides design freedom for meeting various styling needs compared to conventional solutions
- Standard interface allows for minimal effort in product proliferation

PRIMARY APPLICATIONS

- All external car lighting
- LxN family: tail, stop, CHMSL, front fog, DRL
- LED HL module: basic low-beam and high-beam applications
- Modules: rear fog and reverse light

In this ISAL 2017 demonstrator, we display a variety of LED bulbs and standard modules in different optical systems

L1 regulated bulb for simple, reflector-based, front-fog solutions

- Enables a compact front-fog design
- Precise LED placement ensures uniform illumination
- Sharp cut-off of the top beam prevents from glare



HL bulb concept for main-beam functions

- Flat light source form factor enables slim-system architecture
- Direct reference to system optics makes robust system design possible
- Integrated thermal management reduces interface complexity, allowing for design flexibility



LR5 and LW5 regulated bulbs for rear lighting and DRL

- High, luminous flux from a single module, enabling various styling possibilities, including stylish light-guide designs for stop and tail (LR5) and DRL (LW5) lighting
- Easy thermal management and electrical integration in your systems



Rear-fog lighting and backup modules

- Universal modules for rear fog and reverse light applications, meeting ECE R38 and ECE R23 requirements
- Easy mechanical integration into rear combination lights or bumper units
- No electronic drivers required for direct operation on board net
- Standalone in thermal management
- Industry-standard connector types

Regulated LED bulbs - LxN family

Standardized modules

	LR4B	LR5B	LW5B	L1B	Headlamp bulb ¹	Rear-fog module	Back-up module
Function	Stop/tail	Stop/tail, rear fog	DRL, reverse light	Front fog	High beam low beam	Rear fog	Reverse light
Luminous flux [lm]	80/6	120	350	355	500 / 700 / 1000	³	⁴
Voltage range	9V - 16V	9V - 16V	9V - 16V	9V - 16V	Current- driven	9V - 16V	9V - 16V
Typ. power consumption [W]	2.2/0.4	3.0	4.8	4.8	3.3 / 4.5 / 7.0 ²	1.6	3.5
Ambient temperature	-40°C to 85°C	-40°C to 85°C	-40°C to 85°C	-40°C to 85°C	Typ. mission profile	-20°C to 65°C	-20°C to 65°

1 target specifications - 2 thermal power - 3 beam pattern according ECE R38 - 4 beam pattern according ECE R23

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LUXEON Matrix solutions

Matrix solutions for Adaptive Driving Beam (ADB) with smaller and closer spaced dies, enabling more compact optics



The future LED-lighting generation will be created with a true Chip-Size Package (CSP), in which the size of the packaged LEDs is only a few μm larger than the Light Emitting Area (LEA). We demonstrate how future generations of LUXEON Matrix solutions can use this compactness to create a more attractive design for matrix headlighting. Migration to smaller chips than the common 0.5 mm^2 , will allow for even more compact optics.

FEATURES AND BENEFITS

- High-resolution ADB of about 100 pixel, is achieved from a compact module that uses direct projection with a small lens
- Smaller lens and compact matrix module allow for better design options that permit the integration of a matrix functionality into the headlamp
- Rectangular die is used to cover 3° vertically and 18° horizontally reducing the die count, complexity and cost

PRIMARY APPLICATIONS

- LED matrix headlighting
- Adaptive Front-lighting Systems (AFS)
- Adaptive Driving Beam (ADB)

LUXEON Matrix modules with close spacing

Sourcing the matrix module from the LED manufacturer guarantees the best possible performance and quality. The Lumileds matrix platform will always be released with the latest LED technology and thus will allow for faster time-to-market with a reduced development effort. A wide variety of solutions and configurations is already possible based on LUXEON Neo. Our portfolio will be enhanced by offering a solution for close-die spacing.

Design based on 0.5mm² square die

- Matrix module with 24 x 4 pixel covering 2° vertical (0.5° resolution) and 12° horizontal (0.5° resolution) is realized with a single lens of 58 x 76 mm².

Design features

- 4 rows with 24 LED each
- Light Emitting Area (LEA) 760 μm x 760 μm per LED
- Gap between LEAs 60 μm
- Pitch X: 0.82 mm Y: 0.82 mm
- Single-layer ceramic substrate

Design based on a small die (0.21 mm²)

- Matrix module with 3 x 32 pixel covering 3° vertical (1° resolution) and 16° horizontal (0.5° resolution) is achieved with a single lens of 38 x 58 mm².

Design features

- 3 rows with 32 LED each
- Light Emitting Area (LEA) 360 μm x 760 μm
- Gap between LEAs 100 μm
- Pitch X: 0.46 mm Y: 0.86 mm
- Single-layer ceramic substrate

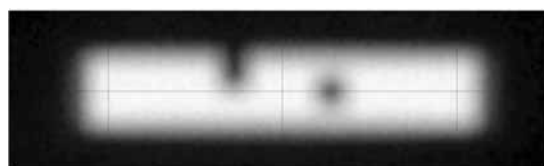
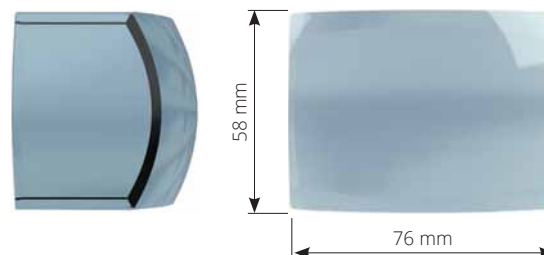
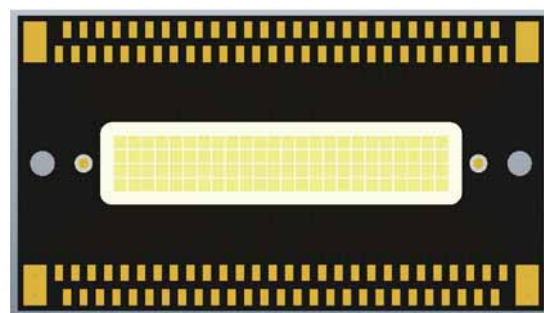
Optical performance from optical simulation

- With a power consumption of 58W, both solutions reach ±120,000 cd in I_{max}. The total flux in beam and therefore its efficiency, is 2x higher for the small die system, due to its shorter focal length.

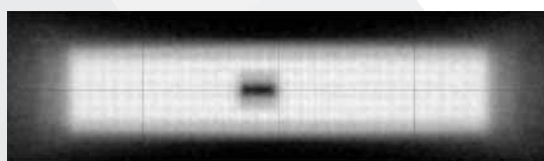
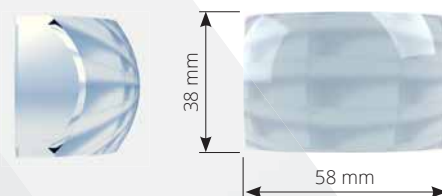
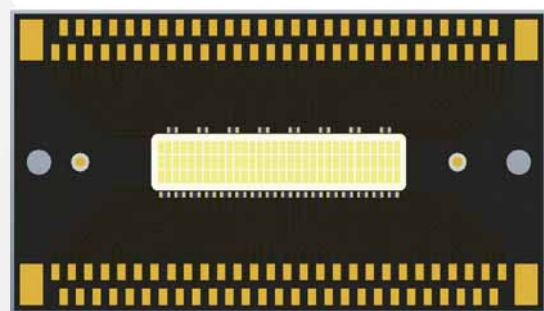
Conclusion

- Direct imaging of close-spaced LEDs is possible for the ADB solution with a pixel count up to 100 LED. In the future, smaller chips will help reduce the size of board and optics, enabling more efficient designs with comparable performance at lower cost.

Design based on 0.5 mm² square die



Design based on a small die (0.21 mm²)



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Micro-optics

applied onto wafer-level-packaged (WLP) LEDs



The new generation, higher-luminance LEDs with smaller-size chip, enable the creation of slimmer headlamp profiles. These introduce an increased optical design challenge, facing a higher-tolerance sensitivity of the optical system. Pre-collimating micro-optics, applied onto WLP LEDs, offer an alternative solution for small and efficient optical design architectures, with longer focal length and lower tolerance sensitivity.

FEATURES AND BENEFITS

Direct, integrated pre-collimating micro-optics applied onto high-luminance LEDs, offer:

- Higher flux extraction efficiency out of the LEDs and an overall higher optical system efficiency
- Better beam homogeneity
- Simpler and more flexible optical architecture design, with less engineering effort due to lower-tolerance sensitivity
- Lower profile height optics create new opportunities to tailor the day- and night-time headlamp signature appearance

PRIMARY APPLICATIONS

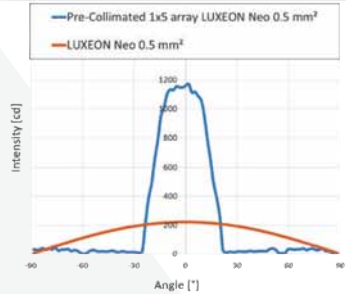
All headlighting contributing functions:

- Low-beam spread and hot spot
- Adaptive Driving Beam (ADB)

LUXEON Neo with pre-collimating micro-optics



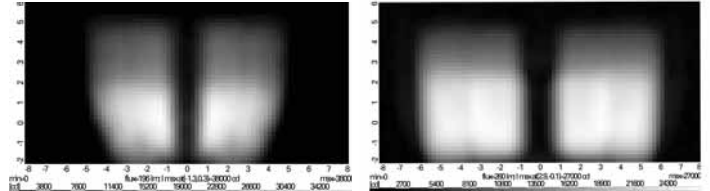
Directly integrated TIR collimating micro-optics onto WLP LED (e.g. LUXEON Neo) with pre-defined air gap



Intensity-distribution pattern of pre-collimated micro-optics vs standard LUXEON Neo

Comparison of a reflector-based ADB system

- ADB array of five LUXEON Neo 0.5 mm²
- In both cases, center LED is switched off
- Applied reflector is 20 x 30 mm² with 80 % reflectivity



compared to

LEDs without pre-collimating optics with 25 mm focal length

LEDs with silicone-based optics with 38 mm focal length

The system with pre-collimating micro-optics has a 50 % higher efficiency and better beam homogeneity.

Headlamp demonstrator

Beam contributors

- Hot spot and spread narrow LUXEON Neo 0.5 mm²
- Spread left and right LUXEON Altilon SMD 1 x 2 mm²
- ADB 4 reflector modules, with each array of 5 LUXEON Neo
- All pre-collimated micro-optics
- Optical profile height: 20 mm

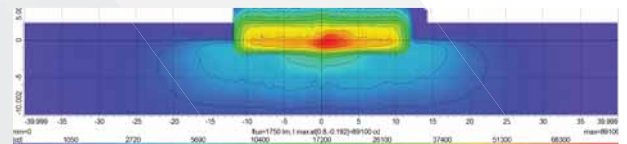
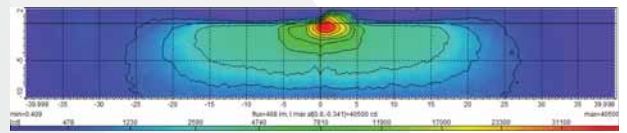
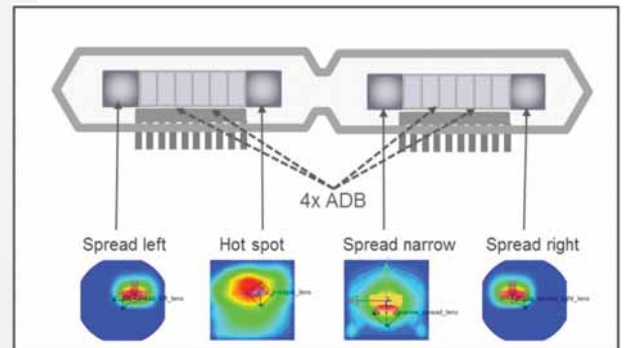
Demo characterization

Low beam

- Total flux: 500 lm
- I_{max}: 40,000 cd
- 75R: 29,000 cd

High beam

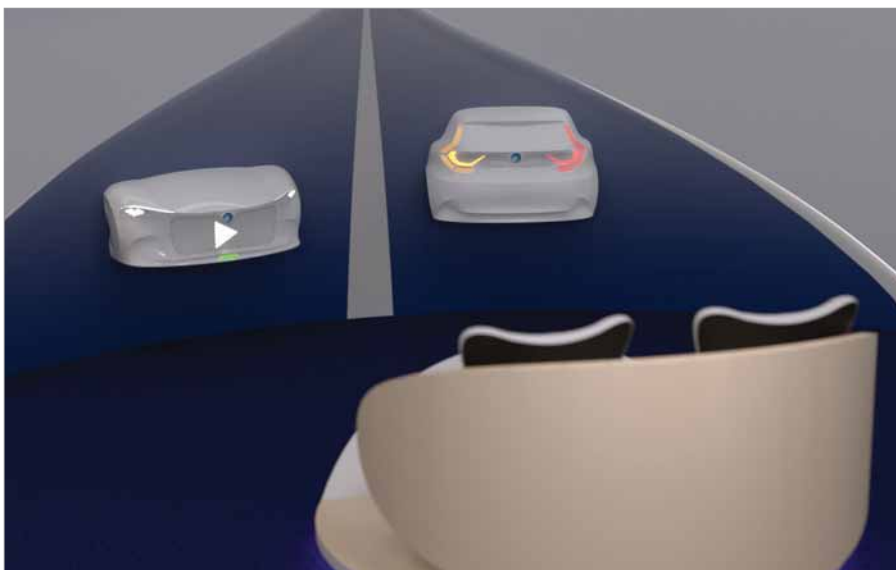
- Total flux: 1,250 lm
- I_{max}: 89,000 cd
- 24° width 6° height





Next generation dynamic signal lighting

Addressing the needs of the Autonomous Driving (AD) era



In signaling, both styling and the application bandwidth are rapidly changing.

Think of all kinds of dynamic lighting scenarios addressing styling, such as Welcome mode and communication signals for Autonomous Driving (AD) cars. Light signals and panels can play an important role in effective communication of AD cars to other road users, so that they feel safe and comfortable.

How to equip the AD era with suitable lighting?

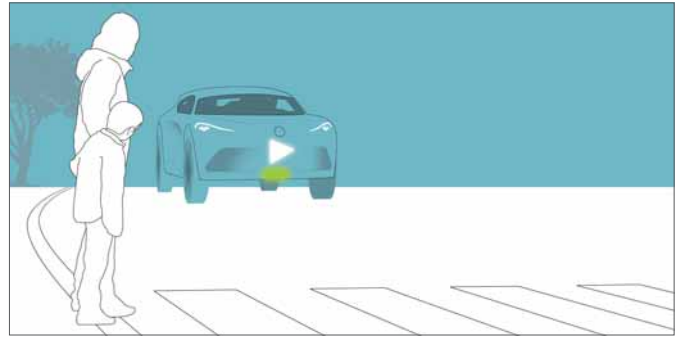
- Where should dynamic signal lighting be located on the vehicle, in order to enable communication between AD cars and other road users?
- What colors will be playing a role in this communication?
- Will there be a need for additional colors for styling reasons?
- What is the required light intensity for a display to be seen during daytime (in sunny conditions)?
- What resolution is suitable to meet the needs of non-autonomous road users?
- Can stylish, elongated signaling patterns play a role in extending existing signal functionality (e.g. emergency stop)?

PRIMARY APPLICATIONS

- Welcome mode scenarios
- Communication signals for AD

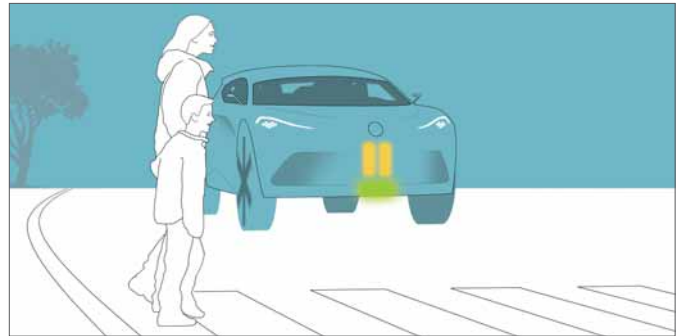
Communication: color and intensity

- Use **dynamic** and **warning** colors (e.g. amber) to **draw attention** in changing situations (e.g. pedestrian crossing)
- If the situation is stable, use steady lighting with **calm** colors
- **Additional colors** can already add value in the current legislation (e.g. Welcome/Coming Home modes) and will become critical to functionality in the future
 - Here we show a bright green AD marker light
 - DRL intensity level will be needed for various situations



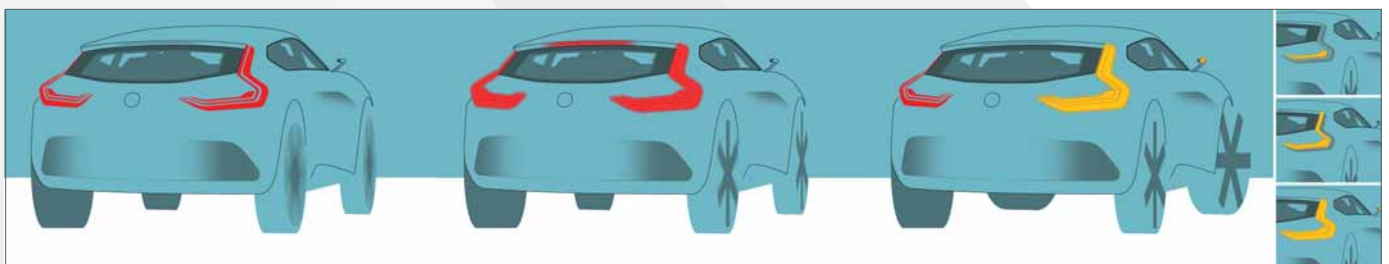
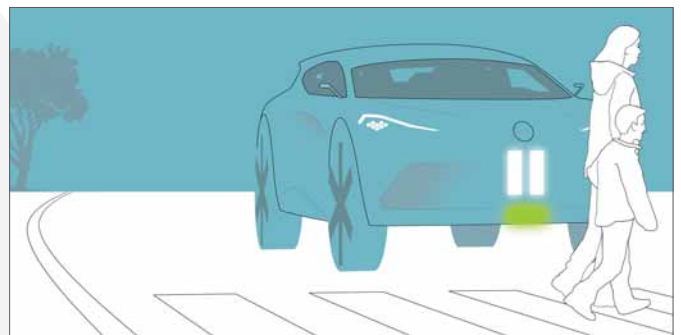
Communication: location and resolution

- Our demonstrator uses **centimeter-sized** elements to display icons (not text)
- Here we use the region between the headlamps as a **communication surface**. Other possibilities exist, such as extending the communications area via projection onto the road surface



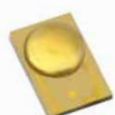
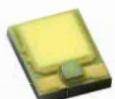
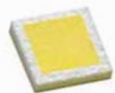
Styling and safety



- **Elongated elements** extend existing signal functionality for additional **safety** and **styling**
- **Dynamics** are used to emphasize signal, thereby improving **visibility**
- In this ISAL 2017 demonstrator, we show elongated elements that **support existing functionality** in RCL



LED front lighting

Portfolio

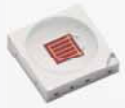


Part name	Part number	CCT / wavelength	LED color	Flux @ bin		Binning condition Tc	Max. DC If	Forward voltage	Max. Tj	Typ rth J-C
				Min	Max					
LUXEON Altilon H1K PnP 1x4	LAPH-M46-XXX	5,500 - 6,250 K		1,107 lm	1,298 lm	85°C	1,000 mA	12.4V	150°C	1.3°C/W
LUXEON Altilon H1K PnP 1x5	LAPH-M56-XXX	5,500 - 6,250 K		1,412 lm	1,603 lm	85°C	1,000 mA	15.5V	150°C	1.1°C/W
LUXEON Altilon SMD 1x2	A1SB-58502DH0	5,180 - 6,250 K		560 lm	620 lm	85°C	1,000 mA	6.0V	150°C	2.3°C/W
LUXEON Altilon SMD 1x3	A1SB-58503DH0	5,180 - 6,250 K		840 lm	930 lm	85°C	1,000 mA	9.0V	150°C	1.8°C/W
LUXEON Altilon SMD 1x4	A1SB-58504DH0	5,180 - 6,250 K		920 lm	1,040 lm	85°C	1,000 mA	12.0V	150°C	1.5°C/W
LUXEON Altilon SMD 1x5	A1SB-58505DH0	5,180 - 6,250 K		1,400 lm	1,550 lm	85°C	1,000 mA	15.0V	150°C	1.2°C/W
LUXEON Neo 1mm²	A1N1-58501DH0	5,180 - 6,250 K		280 lm	310 lm	85°C	1,000 mA	3.0V	150°C	2°C/W
LUXEON Neo 0.5mm²	A1N1-58500BH0	5,180 - 6,250 K		125 lm	140 lm	85°C	500 mA	3.0V	150°C	4.1°C/W
LUXEON F CW	LFMH-C1A	5,180 - 6,250 K		90 lm	110 lm	85°C	350 mA	2.77V	150°C	4°C/W
LUXEON F ES CW	LFXH-C2B	5,500 - 6,680 K		220 lm	240 lm	85°C	700 mA	2.82V	150°C	3°C/W
LUXEON F Plus CW	LFMH-C1C	5,500 - 6,250 K		247 lm	299 lm	85°C	1,000 mA	2.94V	150°C	4°C/W
LUXEON FX Plus CW	A1FX-5850	5,500 - 6,250 K		270 lm	290 lm	85°C	1,000 mA	2.94V	150°C	3.5°C/W
LUXEON F PC Amber	LFMH-L1A	588 - 592 nm		70 lm	90 lm	85°C	350 mA	2.78V	135°C	4°C/W
LUXEON F Plus PC Amber	LFMH-L1C	588 - 592 nm		164 lm	196 lm	85°C	1,000 mA	2.98V	135°C	5°C/W
LUXEON FX Plus PC Amber	A1FX-0591	588 - 592 nm		170 lm	200 lm	85°C	1,000 mA	2.78V	150°C	3.8°C/W
LUXEON Versat 3030 CW 150	A1VA-5850A010	5,500 - 6,250 K		53 lm	70 lm	25°C	150 mA	3.10V	150°C	13°C/W
LUXEON Versat 3030 PCA 150	A1VA-P591A010	588 - 592 nm		30 lm	48 lm	25°C	150 mA	3.10V	150°C	16°C/W
LUXEON Rebel	LXMA-PW01	5,000 - 6,300 K		110 lm	150 lm	25°C	350 mA	2.92V	150°C	10°C/W
LUXEON Rebel PC Amber	LXMA-PL02	588 - 592 nm		90 lm	130 lm	25°C	350 mA	2.92V	135°C	10°C/W
LUXEON Rebel Red Orange	LXMA-PH03	612 - 618 nm		80 lm	110 lm	25°C	350 mA	2.10V	150°C	8°C/W

All specifications are based on MP.

LED rear lighting

Portfolio



Part name	Part number	CCT / wavelength	LED color	Flux @ bin		Binning condition		Max. DC If	Forward voltage	Max. TJ	Typ rth J-C
				Min	Max	Tc	If				
LUXEON Versat 3030 Red Orange 200	A1VA-O612A10	612 - 618 nm		30 lm	52 lm	25°C	200 mA	300 mA	2.60V	150°C	15°C/W
LUXEON Versat 3030 Red Orange 700	A1VA-O612C10	612 - 618 nm		130 lm	224 lm	25°C	700 mA	1 A	2.60V	150°C	5°C/W
LUXEON Versat 3030 Super Red 200 (630 nm)	A1VA-S627A10	627 - 632 nm		18 lm	30 lm	25°C	200 mA	300 mA	2.60V	150°C	15°C/W
LUXEON Versat 3030 Super Red 700 (630 nm)	A1VA-S627C10	627 - 632 nm		75 lm	130 lm	25°C	700 mA	1 A	2.60V	150°C	5°C/W
SignalSure 30 Amber	A1DT-A588L	588 - 595 nm		2.1 lm	3.6 lm	25°C	30 mA	60 mA	2.55V	125°C	100°C/W
SignalSure 75 Amber	A1DP-A588L	588 - 595 nm		7.3 lm	12.5 lm	25°C	75 mA	90 mA	2.67V	135°C	45°C/W
SignalSure 150 Amber	A1DE-A588L	588 - 595 nm		12.5 lm	21.0 lm	25°C	150 mA	200 mA	2.79V	135°C	45°C/W
SignalSure 250 Amber	A1DL-A588L	627 - 632 nm		25.0 lm	52.0 lm	25°C	250 mA	300 mA	2.79V	135°C	25°C/W
SignalSure 30 Red Orange	A1DT-O612L	612 - 618 nm		3.6 lm	6.1 lm	25°C	30 mA	60 mA	3.6V	125°C	100°C/W
SignalSure 75 Red Orange	A1DP-O612L	612 - 618 nm		10.4 lm	18.0 lm	25°C	75 mA	90 mA	2.55V	135°C	45°C/W
SignalSure 150 Red Orange	A1DE-O612L	612 - 618 nm		21.0 lm	36.0 lm	25°C	150 mA	200 mA	2.79V	135°C	45°C/W
SignalSure 250 Red Orange	A1DL-O612L	612 - 618 nm		36.0 lm	62.0 lm	25°C	250 mA	300 mA	2.79V	135°C	25°C/W
SignalSure 30 Super Red	A1DT-S627L	627 - 638 nm		2.1 lm	3.6 lm	25°C	30 mA	60 mA	2.45V	125°C	100°C/W
SignalSure 75 Super Red	A1DP-S627L	627 - 638 nm		6.1 lm	10.4 lm	25°C	75 mA	90 mA	2.79V	135°C	45°C/W
SignalSure 150 Super Red	A1DE-S627L	627 - 632 nm		12.5 lm	21.0 lm	25°C	150 mA	200 mA	2.79V	135°C	45°C/W
SignalSure 250 Super Red	A1DL-S627L	627 - 632 nm		21.0 lm	43.0 lm	25°C	250 mA	300 mA	2.79V	135°C	25°C/W
SnapLED 75 Amber	SSL075-A588	588 - 595 nm		7.3 lm	12.5 lm	25°C	75 mA	75 mA	2.67V	135°C	30°C/W
SnapLED 150 Amber	SSL150-A588	588 - 595 nm		12.5 lm	21.0 lm	25°C	150 mA	150 mA	2.79V	135°C	30°C/W
SnapLED 75 Red Orange	SSL075-O612	613 - 628 nm		10.4 lm	18.0 lm	25°C	75 mA	75 mA	2.67V	135°C	30°C/W
SnapLED 150 Red Orange	A1SS-O612	612 - 618 nm		21.0 lm	36.0 lm	25°C	150 mA	200 mA	2.79V	135°C	30°C/W
SnapLED Xtreme Amber	A1SX-A588	588 - 595 nm		30.0 lm	62.0 lm	25°C	300 mA	350 mA	2.91V	150°C	15°C/W
SnapLED Xtreme Red Orange	A1SX-O612	612 - 618 nm		43.0 lm	75.0 lm	25°C	300 mA	350 mA	2.91V	150°C	15°C/W
SnapLED Xtreme Super Red	A1SX-S627	632 - 632 nm		25.0 lm	52.0 lm	25°C	300 mA	350 mA	2.91V	150°C	15°C/W

All specifications are based on MP.

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Headlighting

Portfolio







Xenon

						
	D1S	D1S NBV	D2S	D2S NBV	D2R	D3S
Type Nr.	85410	85415 NBV	85122	85122 NBV	85126	42403
Voltage	85V	85V	85V	85V	85V	42V
Power	35W	35W	35W	35W	35W	35W
Lumen output	3,200 lm	3,200 lm	3,400 lm	3,400 lm	2,800 lm	3,200 lm
Lifetime B3	2,000 h	2,000 h	1,500 h	1,500 h	1,500 h	2,000 h
Lifetime Tc	3,000 h	3,000 h	2,500 h	2,500 h	2,500 h	3,000 h
Regulations	R99/DOT	R99/DOT	R99/DOT	R99/DOT	R99/DOT	R99/DOT

						
	D3S NBV	D4S	D4S NBV	D4R	D4R NBV	D5S
Type Nr.	42403 NBV	42402	42402 NBV	42406	42406 NBV	12410
Voltage	42V	42V	42V	42V	42V	13.2V*
Power	35W	35W	35W	35W	35W	25W
Lumen output	3,200 lm	3,200 lm	3,200 lm	2,800 lm	2,800 lm	2,000 lm
Lifetime B3	2,000 h	2,000 h	2,000 h	2,000 h	2,000 h	2,500 h
Lifetime Tc	3,000 h	3,000 h	3,000 h	3,000 h	3,000 h	4,000 h
Regulations	R99/DOT	R99/DOT	R99/DOT	R99/DOT	R99/DOT	R99/DOT

*Test voltage

Halogen

						
	H4 LL	H4 HPLL	H4 HP+	H4 BV+	H7	H7 LL
Type Nr.	12342 LL	12342 HPLL	12342 HP+	12342 BV+	12972	12972 LL
Voltage*	13.2V	13.2V	13.2V	13.2V	13.2V	13.2V
Power	60/55W	60/55W	60/55W	60/55W	55W	55W
Lumen output	1,650/1,000 lm	1,650/1,000 lm	1,750/1,100 lm	1,650/1,000 lm	1,500 lm	1,500 lm
Lifetime B3	900 h	2,000 h	400 h	200 h	330 h	700 h
Lifetime Tc	1,500 h	3,000 h	700 h	400 h	550 h	1,100 h
Regulations	R37	R37	R37	R37	R37/DOT	R37/DOT

*Test voltage

Headlighting

Portfolio

Halogen



	H7 HPLL	H7 BV+**	H8 LL	H8 BV+	H9	H9 BV+	H11 LL
Type Nr.	12972 HPLL	12972 BV+	12360	12360 BV+	12361	12361 BV+	12362 LL
Voltage*	13.2V	13.2V	13.2V	13.2V	13.2V	13.2V	13.2V
Power	55W	55W	35W	35W	65W	65W	55W
Lumen output	1,500 lm	1,500 lm	800 lm	800 lm	2,100 lm	2,100 lm	1,350 lm
Lifetime B3	1,000 h	200 h	800 h	200 h	270 h	200 h	1,000 h
Lifetime Tc	1,500 h	350 h	1,500 h	400 h	540 h	400 h	2,000 h
Regulations	R37/DOT	R37/DOT	R37/DOT	R37/DOT	R37/DOT	R37/DOT	R37/DOT

*Test voltage

**Also available with blue top coating



	H11 BV+	H18 LL	H18 HPLL	H19 LL	HIR2	HIR2 LL
Type Nr.	12362 BV+	12643 LL	12643 HPLL	12644 LL	9012	9012 LL
Voltage*	13.2V	13.2V	13.2V	13.2V	13.2V	13.2V
Power	55W	65W	65W	60/55W	55W	55W
Lumen output	1,350 lm	1,700 lm	1,700 lm	1,750/1,200 lm	1,875 lm	1,875 lm
Lifetime B3	200 h	700 h	1,000 h	900 h	500 h	900 h
Lifetime Tc	350 h	1,100 h	2,000 h	1,500 h	900 h	1,400 h
Regulations	R37/DOT	R37/DOT	R37/DOT	R37/DOT	R37/DOT	R37/DOT

*Test voltage



	PSX24W	PSX26W
Type Nr.	12276	12278
Voltage*	13.2V	13.2V
Power	23.5W	23.5W
Lumen output	465 lm	465 lm
Lifetime B3	1,000 h	1,000 h
Lifetime Tc	2,000 h	2,000 h
Regulations	R37	R37

*Test voltage

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Two-wheeler

Portfolio

Headlighting - xenon



	D1R	D1R NBV	D5S
Type Nr.	85409	85409	12410
Voltage	85V	85V	12V
Power	35W	35W	25W
Lumen output	2,800 lm	2,800 lm	2,000 lm
Lifetime B3	2,000 h	2,000 h	2,500 h
Lifetime Tc	3,000 h	3,000 h	4,000 h
Regulations	R99/DOT	R99/DOT	R99/DOT

Headlighting - halogen



	H4 ED	H4 BV+	H7	H7 LL	H7 BV+*	H17 ED
Type Nr.	12342	12342	12972	12972 LL	12972 BV+	12642
Voltage	12V	12V	12V	12V	12V	12V
Power	60/55W	60/55W	55W	55W	55W	35/35W
Lumen output	1,650/1,000 lm	1,650/1,000 lm	1,500 lm	1,500 lm	55W	900/600 lm
Lifetime B3	350 h	200 h	330 h	700 h	180 h	HB 100 / LB 200
Lifetime Tc	700 h	400 h	550 h	1,100 h	350 h	HB 200 / LB 400
Regulations	R37	R37	R37/DOT	R37/DOT	R37/DOT	R37

*Also available with blue top coating



	H18 LL	H18 HPLL	H19 LL	HS1 ED	HS1 LL	HS1 HP
Type Nr.	12643 LL	12643 HPLL	12644 LL	12636	12636	12636
Voltage	12V	12V	12V	12V	12V	12V
Power	65W	65W	60/55W	35/35W	35/35W	35/35W
Lumen output	1,700 lm	1,700 lm	1,750/1,200 lm	825/525 lm	825/525 lm	825/525 lm
Lifetime B3	700 h	1,000 h	900 h	HB 100 / LB 200	HB 100 / LB 300	HB 100 / LB 200
Lifetime Tc	1,100 h	2,000 h	1,500 h	HB 200 / LB 400	HB 200 / LB 600	HB 200 / LB 400
Regulations	R37/DOT	R37/DOT	R37/DOT	R37	R37	R37

Two-wheeler

Portfolio

Signaling



	PR21W	PR21/5W	P21/5W ED	P21/5W LL	PY21W NA LL	PY21W SV
Type Nr.	12088	12495	12499 ED	12499 LL	12496 NA LL	12496 SV
Voltage	12V	12V	12V	12V	12V	12V
Power	25W	21/5W	21/5W	21/5W	21W	21W
Lumen output	110 lm	105/8 lm	440/35 lm	440/35 lm	280 lm	280 lm
Lifetime B3	250 h	450/800 h	275/600 h	500/800 h	500 h	250 h
Lifetime Tc	600 h	1,000/2,000 h	500/1,600 h	1,250/2,000 h	1,000 h	500 h
ECE reg.	R37	R37	R37	R37	R37	R37



	RY10W NA	RY10W NA ED	W5W NBV	W5W NBV LL	R10W ED
Type Nr.	12093 NA	12093 NA ED	12961 NBV	12961 NBV LL	12814 ED
Voltage	12V	12V	12V	12V	12V
Power	10W	10W	5W	5W	10W
Lumen output	75 lm	75 lm	50 lm	50 lm	125 lm
Lifetime B3	400 h	400 h	500 h	900 h	250 h
Lifetime Tc	1,000 h	1,000 h	1,500 h	2,000 h	625 h
ECE reg.	R37	R37	R37	R37	R37

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Truck lighting

Portfolio

Headlighting - xenon



	D3S	D3S NBV	D4S	D4R
Type Nr.	42403	42403 NBV	42402	42406
Voltage	42V	42V	42V	42V
Power	35W	35W	35W	35W
Lumen output	3,200 lm	3,200 lm	3,200 lm	2,800 lm
Lifetime B3	2,000 h	2,000 h	2,000 h	2,000 h
Lifetime Tc	3,000 h	3,000 h	3,000 h	3,000 h
Regulations	R99/DOT	R99/DOT	R99/DOT	R99/DOT

Headlighting - halogen



	H1 ML	H3 ML	H4 ML	H7 ML	H11 ML
Type Nr.	13258 ML	13336 ML	13342 ML	13972 ML	24362 ML
Voltage	24V	24V	24V	24V	24V
Power	70W	70W	75/70W	70W	70W
Lumen output	1,900lm	1,750 lm	1,900/1,135 lm	1,750 lm	1,600 lm
Lifetime B3	500 h	500 h	900 h	700 h	850 h
Lifetime Tc	1,000 h	1,200 h	1,800 h	1,200 h	1,500 h
Regulations	R37	R37	R37	R37	R37


Truck lighting

Portfolio

Signaling



	W3W	W5W	P21W ML	P21W MD	PY21W NA ML	P21/5W
Type Nr.	13256	13961	13498 ML	13498 MD	13496 ML	13499
Voltage	24V	24V	24V	24V	24V	24V
Power	3W	5W	21W	21W	21W	21/5W
Lumen output	22 lm	50 lm	440 lm	460 lm	280 lm	440/40 lm
Lifetime B3	400 h	450 h	500 h	125 h	250 h	150/600 h
Lifetime Tc	3,000 h	1,500 h	1,250 h	300 h	500 h	400/1,600 h
ECE reg.	R37	R37	R37	R37	R37	R37



	R5W MD	R5W ML	R10W MD	R10W ML	PSX26W (+ converter)
Type Nr.	13821 MD	13821 ML	13814 MD	13814 ML	12278
Voltage	24V	24V	24V	24V	12V
Power	5W	5W	10W	10W	24W
Lumen output	50 lm	50 lm	125 lm	125 lm	500 lm
Lifetime B3	400 h	800 h	400 h	800 h	750 h
Lifetime Tc	1,000 h	2,000 h	1,000h	2,000 h	1,500 h
ECE reg.	R37	R37	R37	R37	R37

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Signaling

Portfolio







HiPerVision

Bulbs with NCC (WP3.3x14.5 cap)

						
	PW16W HTR	PW19W HTR	PW24W HTR	PWY16W NA HTR	PWY19W NA HTR	PWY24W NA HTR
Type Nr.	12177 HTR	12183 HTR	12182 HTR	12176 HTR	12178 HTR	12174 HTR
Voltage	12V	12V	12V	12V	12V	12V
Power	16W	19W	24W	16W	19W	24W
Lumen output	300 lm	350 lm	500 lm	180 lm	215 lm	300 lm
Lifetime B3	1,500 h	1,000 h	750 h	1,200 h	1,200 h	1,200 h
Lifetime Tc	3,000 h	2,000 h	1,500 h	2,400 h	2,400 h	2,400 h
ECE reg.	R37	R37	R37	R37	R37	R37





Bulbs with NCC

Bulbs with PG20 cap

						
	PWY24W SV HTR	PS19W	PSY19W NA	PSX24W	PSY24W NA	PSY24W SV+
Type Nr.	12174 HTR	12085	12275	12276	12188	12180 SV+
Voltage	12V	12V	12V	12V	12V	12V
Power	24W	19W	19W	24W	24W	24W
Lumen output	300 lm	350 lm	215 lm	500 lm	300 lm	300 lm
Lifetime B3	1,000 h	1,000 h	1,200 h	750 h	1,200 h	1,000 h
Lifetime Tc	2,000 h	2,000 h	2,400 h	1,500 h	2,400 h	2,000 h
ECE reg.	R37	R37	R37	R37	R37	R37

Bulbs with PGU20 cap






Bulbs with PG18.5 cap

				
	PY24W NA	PY24W SV+	P13W	PSX26W
Type Nr.	12190	12274 SV+	12277	12278
Voltage	12V	12V	12V	12V
Power	24W	24W	17W	24W
Lumen output	300 lm	300 lm	250 lm	500 lm
Lifetime B3	1,200 h	1,000 h	4,000 h	750 h
Lifetime Tc	2,400 h	2,000 h	8,000 h	1,500 h
ECE reg.	R37	R37	R37	R37

Signaling

Portfolio

Conventional wedge base

					
	W5W NBV	W5W NBV LL	WB T10 6W 12V	WY5W NA	WB T10 6,1W 12V
Type Nr.	12961 NBV	12961 NBV LL	12040	12396 NA	12037
Voltage	12V	12V	12V	12V	12V
Power	5W	5W	6W	5W	6,1W
Lumen output	50 lm	50 lm	84 lm	30 lm	105 lm
Lifetime B3	500 h	900 h	500 h	1,300 h	100 h
Lifetime Tc	1,500 h	2,000 h	1,500 h	3,000 h	200 h
ECE reg.	R37	R37	-	R37	-

Conventional bayonet BA15

						
	P21/5W XL	PR21W	PR21/5W	PY21W SV	PY21W NA	PY21W NA LL
Type Nr.	12499 XL	12088	12495	12496 SV	12496 NA	12496 NA LL
Voltage	12V	12V	12V	12V	12V	12V
Power	21/5W	21W	21/5W	21W	21W	21W
Lumen output	440/35 lm	110 lm	105/8 lm	280 lm	280 lm	280 lm
Lifetime B3	1,500/4,000 h	250 h	450/800 h	250 h	250 h	500 h
Lifetime Tc	3,000/8,000 h	600 h	1,000/2,000 h	500 h	500 h	1,000 h
ECE reg.	R37	R37	R37	R37	R37	R37

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