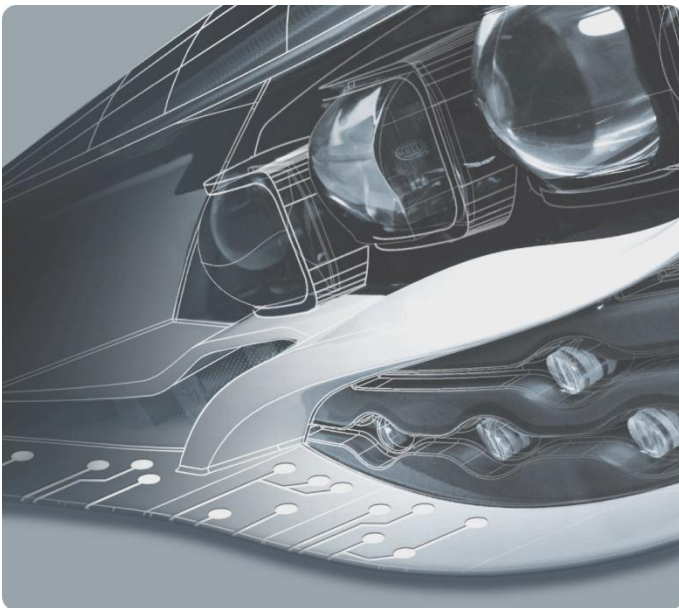




Technology with Vision




Overview

Business Division Lighting



HELLA Group

Top Topics within the global Trends

The HELLA lighting fields of innovation	
	<p>Styling: Supporting the emotional links to the car and making the topics environment and safety visible</p>
	<p>Light based driver assistant systems: Creating a maximum safety by giving the driver the best possible visibility under all driving and weather conditions</p>
	<p>LED: Energy efficient lighting systems with maximum efficiency to reduce the total energy consumption of the car and long lifetime to create a cleaner environment</p>

The HELLA Lighting motivation

Approx. **30%** of all accidents occur at night

50 % of all accidents are the result of
shortcomings in visual perception

The human brain absorbs **90%**
of all information through the eyes

The eye is the weak link at night



Business Division Lighting Competences

INTERIOR LIGHTING



SMALL LAMPS



COMPONENTS



REAR LAMPS



LIGHT BASED DRIVER
ASSISTANT SYSTEMS

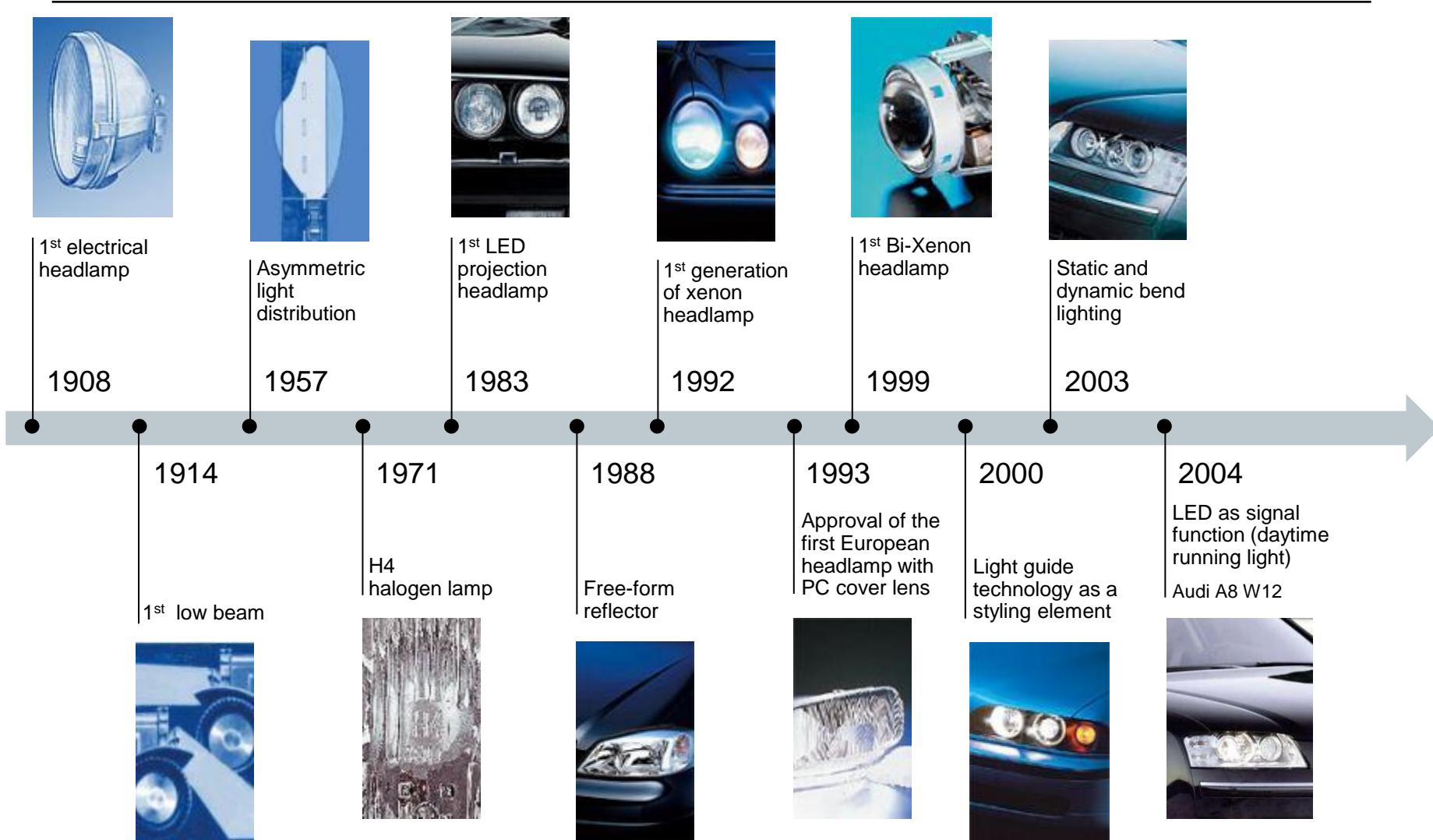


HEADLAMPS



Headlamps

Milestones from 1990 to 2004



Headlamps

Milestones from 2006 on



1st full-AFS headlamp
Mercedes E-Class
Opel Insignia

2006



Camera based
headlamp with
adaptive Cut-off
Line

Mercedes E-Class
(1st to market)

2009



Camera based
headlamp with glare-
free high beam

VW Touareg
(1st to market)

2011



Full-LED headlamp with
glare-free high beam

Mercedes E-Class
(1st to segment)

2013

2008

Full-LED headlamp

Cadillac
Escalade
Platinum
(1st to segment)



2010

Full-LED headlamp
with AFS-functions

Audi A8
(1st to market)



2012

Headlamp with LED
main beam function for
truck segment

DAF XF/CF
(1st to market)



LED Matrix headlamp with
glare-free high beam

Audi A8 (1st to market)



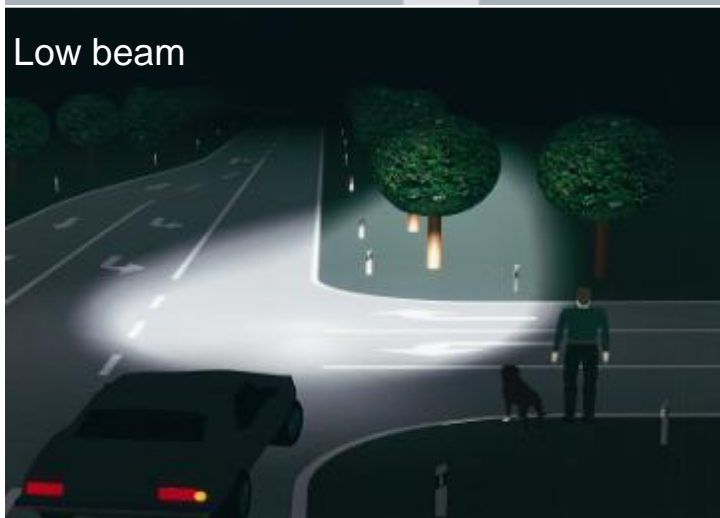
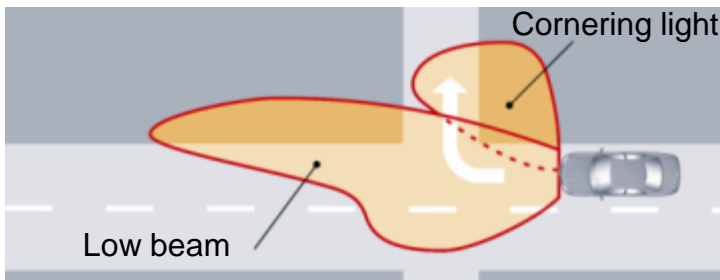
Headlamps | Dynamic Lighting Systems

Static Bend Light/ Cornering Light

Sensorial data of the vehicle infrastructure



In narrow corners, entry gateways or crossings an additional lighting system is switched on and accompanies the low beam. Through the light radiation of up to 90°, the lighting of the crossing area increases. An activation is effected by operating the winker or as a function of speed.



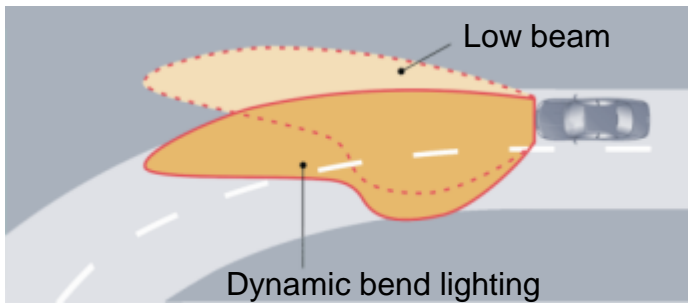
Headlamps | Dynamic Lighting Systems

Dynamic Bend Lighting

Sensorial data of the vehicle infrastructure



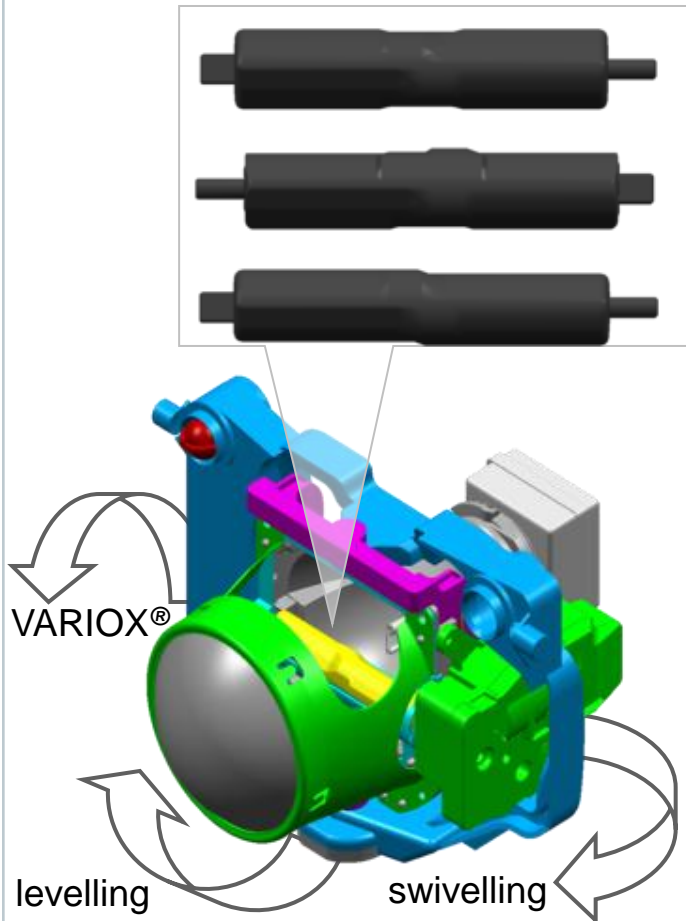
Low beam and high beam are turned via actuators based on the calculated bend geometry.



Headlamps I Dynamic Lighting Systems

Lighting Modules

Modules

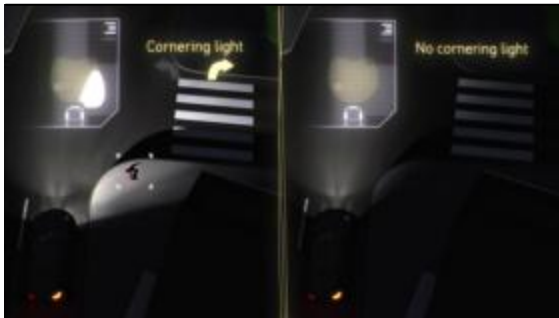


VarioLED

Adaptive frontlighting system (AFS)
Adaptive Cut-off Line (aCOL)
Vertical Cut-off Line (vCOL)

Headlamps | Dynamic Lighting Systems

Adaptive Frontlighting System (AFS)



CORNERING LIGHT



DYNAMIC BEND LIGHT



ADVERSE WEATHER-LIGHT



MOTORWAY LIGHT



COUNTRY LIGHT

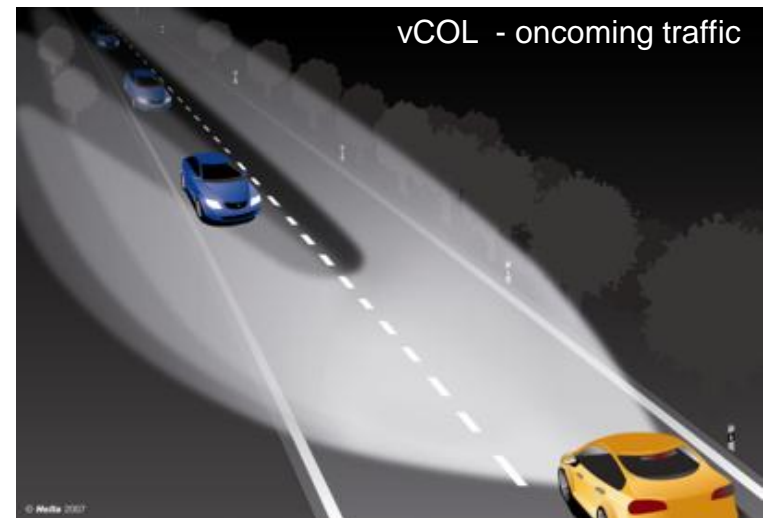


TOWN LIGHT

Headlamps | Dynamic Lighting Systems

Camera-based Lighting Systems

Glaring parts of the high beam lighting distribution are **automatically faded out**.
SOP 2010 in e.g. VW Touareg



Components of a camera-based lighting system



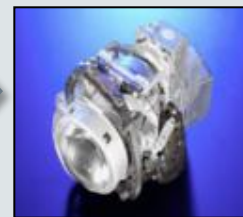
Camera



Image
processing



Lighting
electronics



Lighting
technology



Headlamp

Headlamps | Dynamic Lighting Systems

Adaptive Cut-off-Line (aCOL)

Adaptive Cut-off-Line with Xenon and LED

The „Adaptive Cut-off Line“ controls the **light range** depending on the **distance to oncoming traffic** and to **traffic ahead**.

The **visibility range** of the **driver** is **increased** – **glare** of the traffic is **avoided**.



Headlamps | Dynamic Lighting Systems

Glare-free High Beam (vCOL)

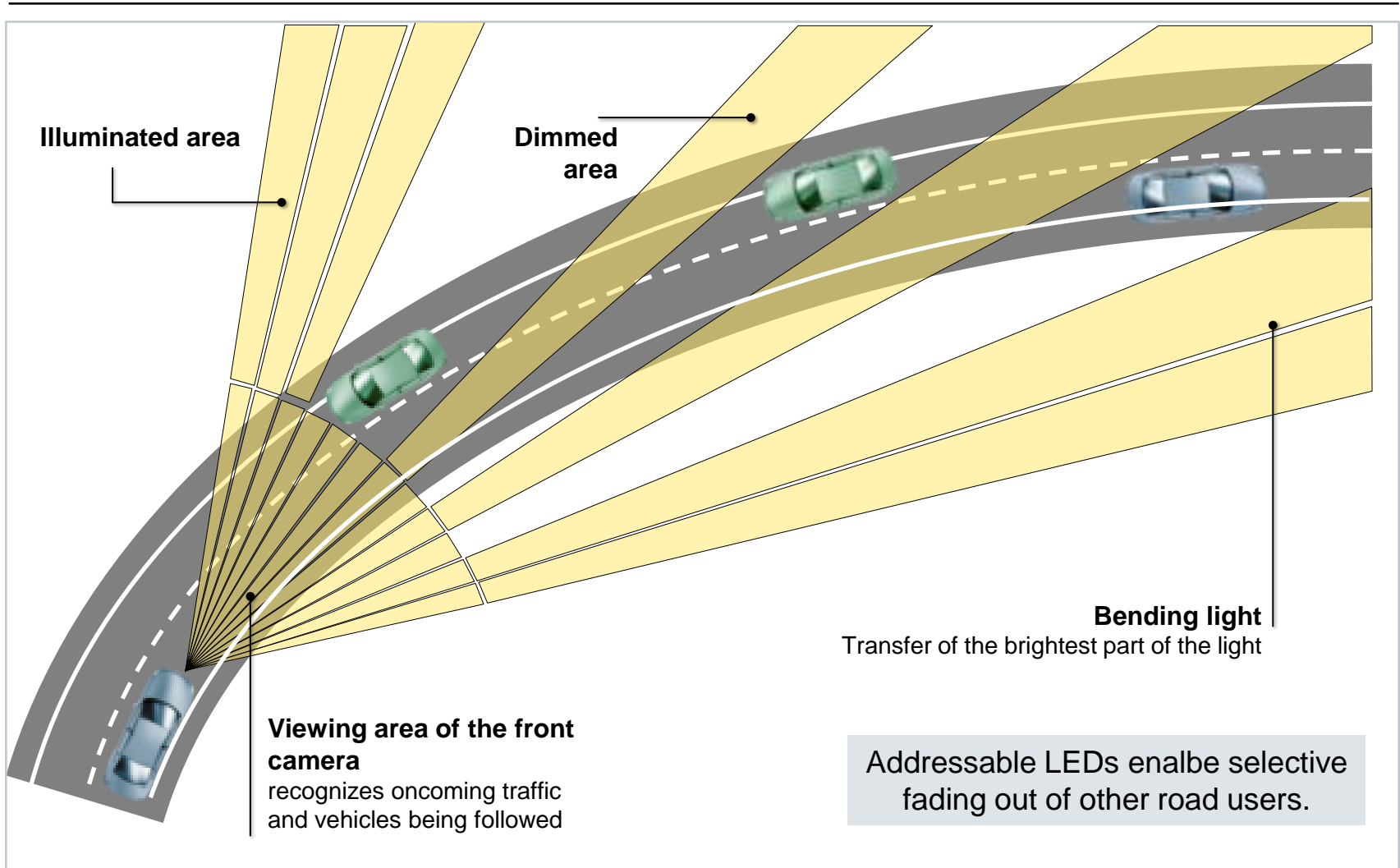
Glare-free high beam with Xenon and LED

With **glare-free high beam** in most traffic situations a light distribution comparable to high beam is available for the driver. In case of **oncoming or heading traffic** the **glaring parts** of the high beam lighting distribution are **automatically faded out**.



Headlamps I LED Matrix Beam

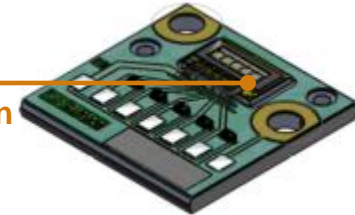
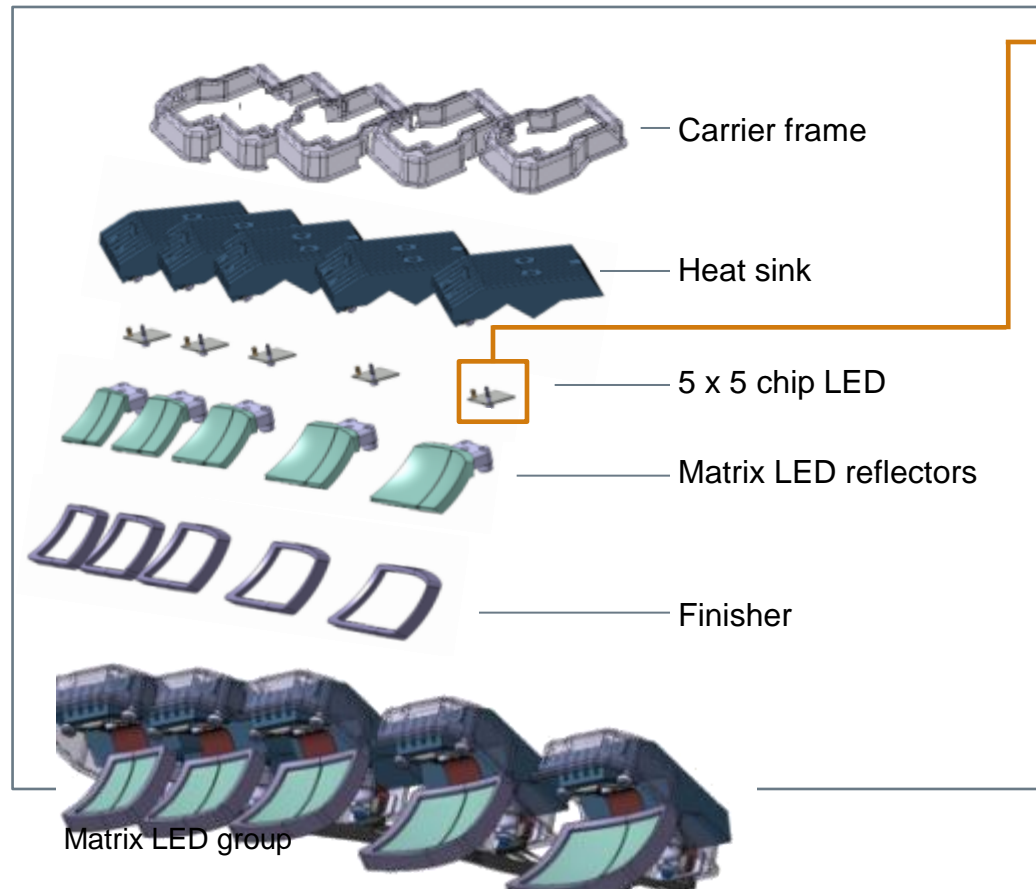
Operating Principle



Headlamps I Matrix LED

Market Innovation

USP: 5 reflectors, each with a 5 chip LED



5 LEDs on one chip

MARKET INNOVATION

Each LED Chip on the PCB is controlled **individually**. Up to now it was only possible to switch on/off the whole cluster/package.

ELECTRONIC APPROACH

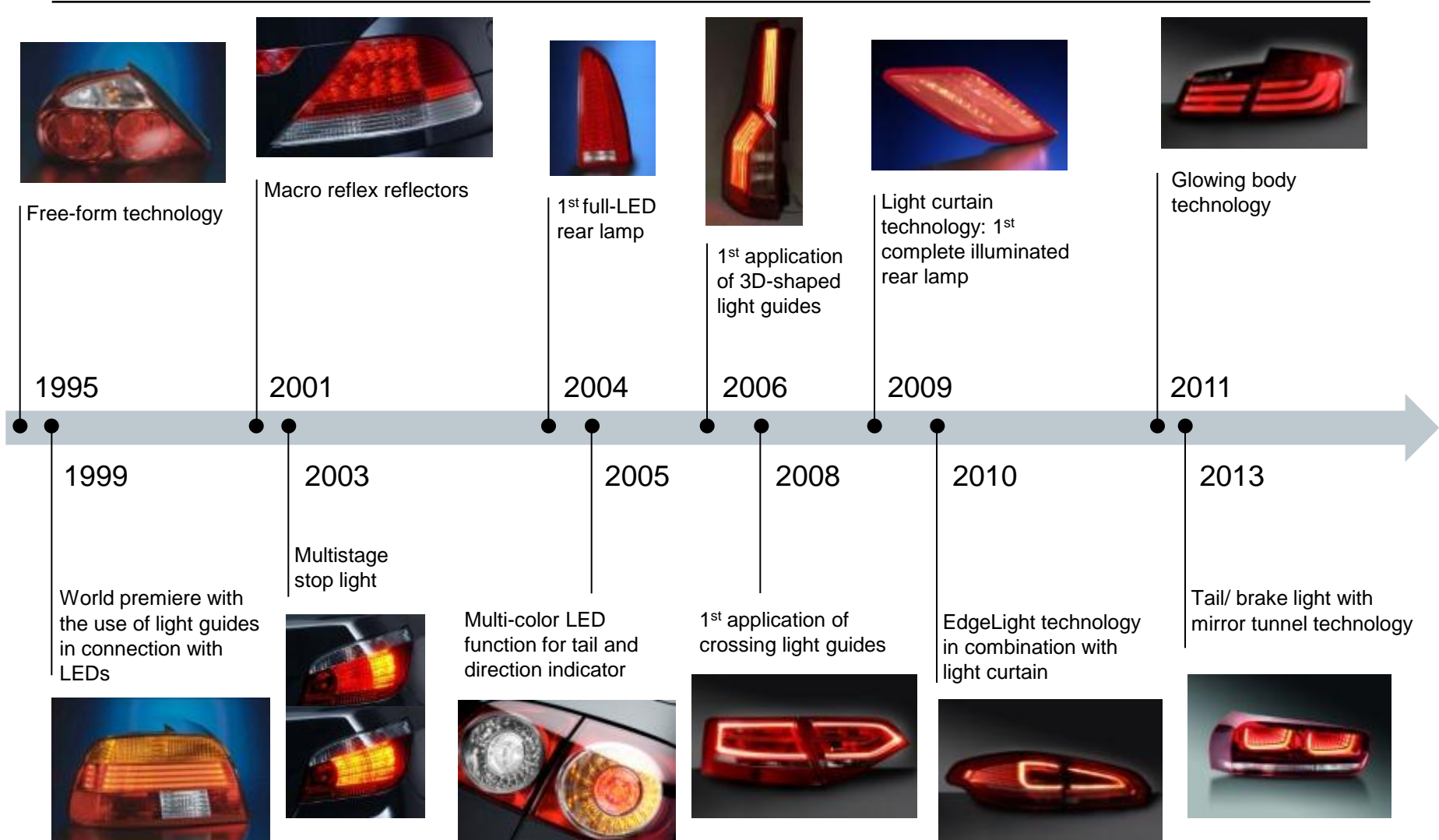
LED is the only light source that can be continuous **dimmed** btw 0 and 100%. This characteristics is been used to create an dynamic light system **without mechanical moving parts**

Masking out of up to **8 different road users**

Driving with high beam **without glaring**

Rear Lamps

Milestones from 1995 on



Rear Lamps | Current Styling Trends

Technical Accentuation – HELLA Solutions

DIRECT REFLECTOR

- Relative simple design especially for compact to mid size cars
- Each LED has its own reflector



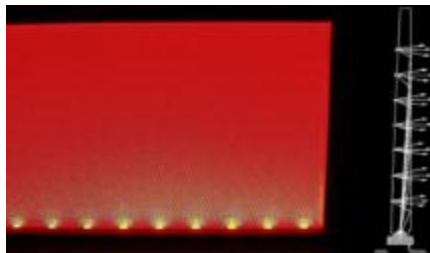
INDIRECT REFLECTOR

- LEDs not visible
- “Light coming from nowhere”
- Separate reflector sections for each LED



LIGHT CURTAIN

- Light guide as planar surface
- LEDs along the edge
- Optical structures on the surface



EDGE LIGHT TECHNOLOGY

- Illumination of small lighting edges
- Light emits from the edge by using structures or optics



Rear Lamps | Current Styling Trends

Technical Accentuation – HELLA Solutions

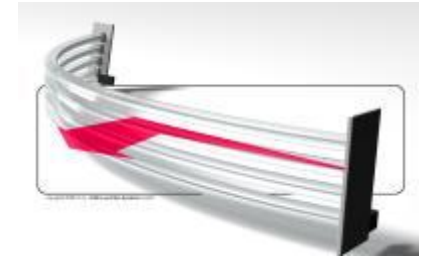
GLOWING BODY

- 3-dimensional bar, which seems to glow
- LEDs on substrate emit the light directly
- Homogeneous lit structures



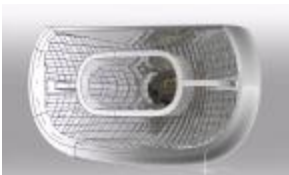
PRISM LIGHT GUIDE

- Linear and homogenous illumination
- Two- or three-dimensional designs possible



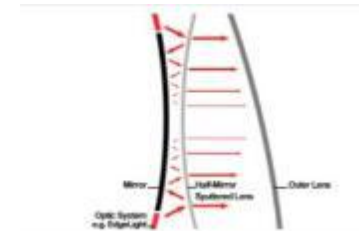
DOUBLE REFLECTOR

- two-dimensional background light
- High photometric efficiency
- Single-part system or matrix of multiple reflectors



MIRROR TUNNEL

- Tunnel-type depth effect
- Open or closed contour possible
- Reflective paths are controlled via mirror surface



Interior Lighting

Milestones from 1969 on



Display lamp as after-market product

1969



1st European central patent for light guide symbol lighting with only one LED Volvo

1995



Europe-wide 1st application of light guide technology for ambient interior lighting BMW

2001



Leading role in the field of using complex light guide technology in overhead consoles

2010



RGB-LED ambient lighting
Further projects:
Material backlighting
Opel Adam, Range Rover

2013

1984

1st Europe wide integration of electronic in interior lighting

Volvo



1998

Worldwide unique patented process to produce radar covers



2007

Installation space optimized interior reading light in LED technology for convertibles

Audi



2012

Light guide in panoramic roof and door panels

VW Golf 7, Peugeot 208



2014

RGB-LED ambient lighting. Further projects: Complex overhead consoles

BMW X5



Interior Lighting Product Range

DOME LAMP



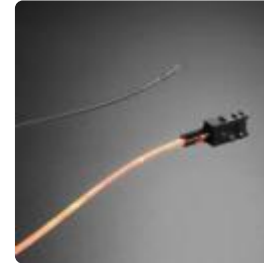
ROOF
CONTROL
UNITS



AMBIENT
LIGHTING



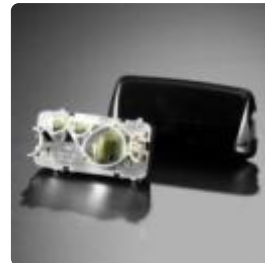
MINIATURE LAMPS



LIGHTING AND ELECTRONIC
MODULES



SENSORS



RADOMES*



* Radomes belong to the product portfolio of HELLA Innenlicht-Systeme GmbH (HIS) that is competence center for interior lighting

Interior Lighting

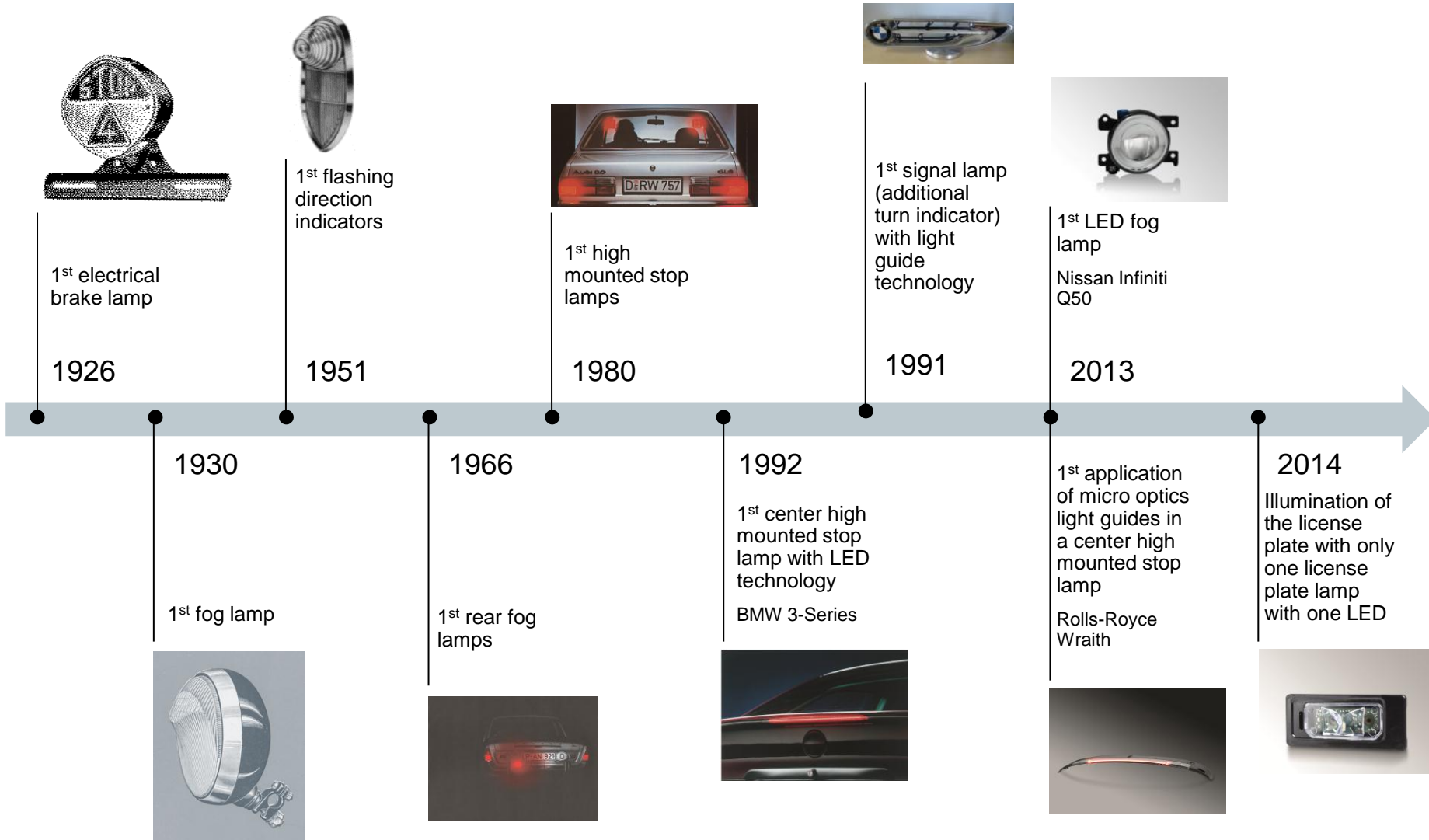
Ambient Lighting



Concept development, optical design, simulation, manufacturing of optical components, light source integration, electronical control units, class A-surface capabilities as HELLA core competences

Small Lamps

Milestones from 1926 on



Small Lamps

Product Overview

FOG LAMPS



CENTER HIGH MOUNTED STOP LAMPS



LICENSE PLATE LAMPS



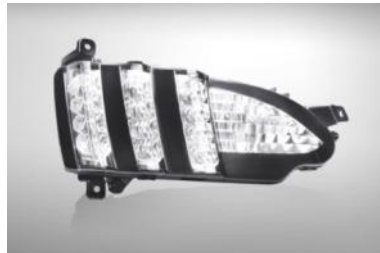
FRONT COMBINATION LAMPS



REAR SIGNAL LAMPS



DAYTIME RUNNING LIGHTS

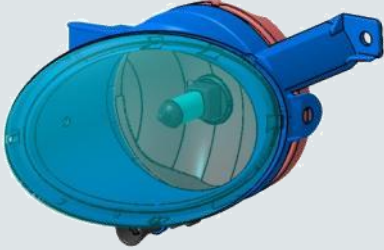



INDICATOR LAMPS



Small Lamps | Fog Lamps

Current HELLA Concepts

Concept	Application	Description	Customer Benefits
OFL Concept		<ul style="list-style-type: none"> → Standard reflector group → Standard light sources used (H8, H11, HB4) → Customer specific lens and housing → O-ring for tightening reflector and housing during adjusting 	<ul style="list-style-type: none"> → Low weight → Small package space → Cost effective (COP reflector group) → Different functions with changing just reflector
CFL Concept		<ul style="list-style-type: none"> → No standard parts except small parts (ventilation, adjustment parts,..) → Standard light sources used (H8, H11, HB4, P21W, PS19W,...) → Customer specific lens, housing, bezel, reflectors → Rubber membrane or thin plastic wall for adjustment 	<ul style="list-style-type: none"> → Very flexible to meet customer styling → More functions in one device → More versions in one housing for different car levels possible (eg. Fog – DRL, Fog – Cornering Light, only DRL,...)

Small Lamps | Front Combination Lamps

More than just one Function



Description

- Bulb and/ or LED light sources
- Integration of different front lighting functions in one housing (except low beam)
 - Fog lamp
 - Position light
 - Turn indicator
 - Daytime running light
 - Cornering light
 - Additional high beam

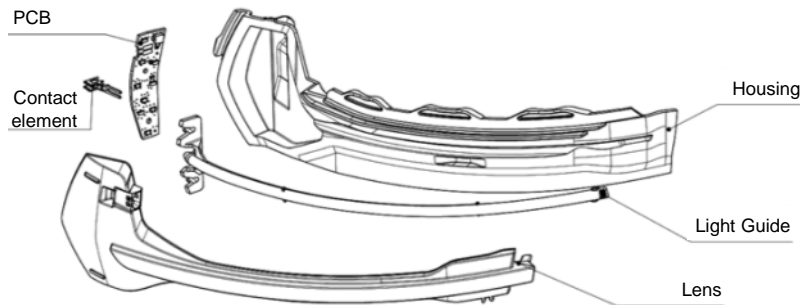
Advantages

- Customer-specific range of functions
- Saves space in the headlamp
- Product that combines function, technology and styling
- Differentiation of vehicle lines by integration of different functions or different styling
- Cost effective solutions by implementation of standard reflectors (OFL approach)

Small Lamps | Side Mirror Applications

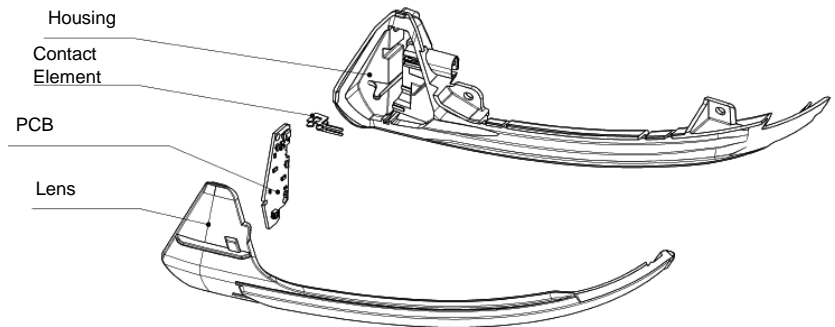
Turn Indicator integrated in Side View Mirror // Light Guide Solutions

SEPARATED LIGHT GUIDE

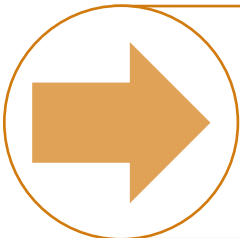


- Efficient optical system
- Optical system extensively independent from design surface
- Smaller tolerances because molding parameters can be optimized to dimensions

INTEGRATED IN LENS



- Optical system less efficient than with separate light guide
- Design surface has big influence to photometric part
- Cost effective solution due to light guide and lens as one part

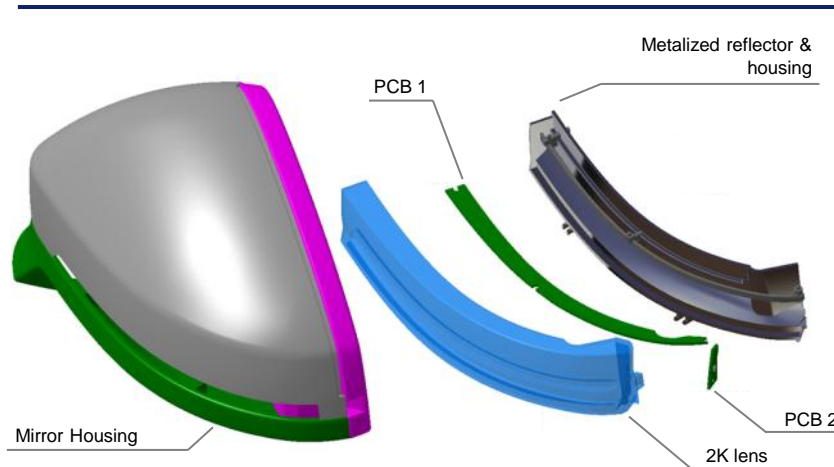


- Customized application possibilities
- HELLA inhouse LED light source and optical system competence
- Independent from mirror manufacturer
- Cost efficient lamp construction with two plastic components possible

Small Lamps | Side Mirror Applications

Turn Indicator integrated in Side View Mirror // Further Solutions

REFLECTOR

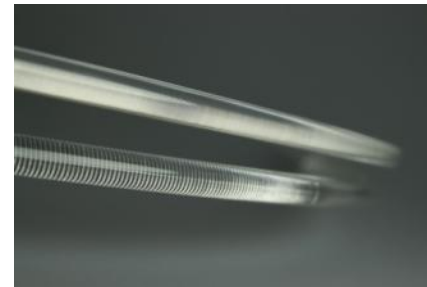


- Implementation of translucent material for better homogeneity
- Multi-part construction with reflector, lens and PCB
- Implementation of elongated PCB with several LEDs allows for sequential turn indicator

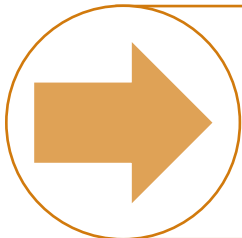
IMPROVED HOMOGENEITY...



...with translucent material

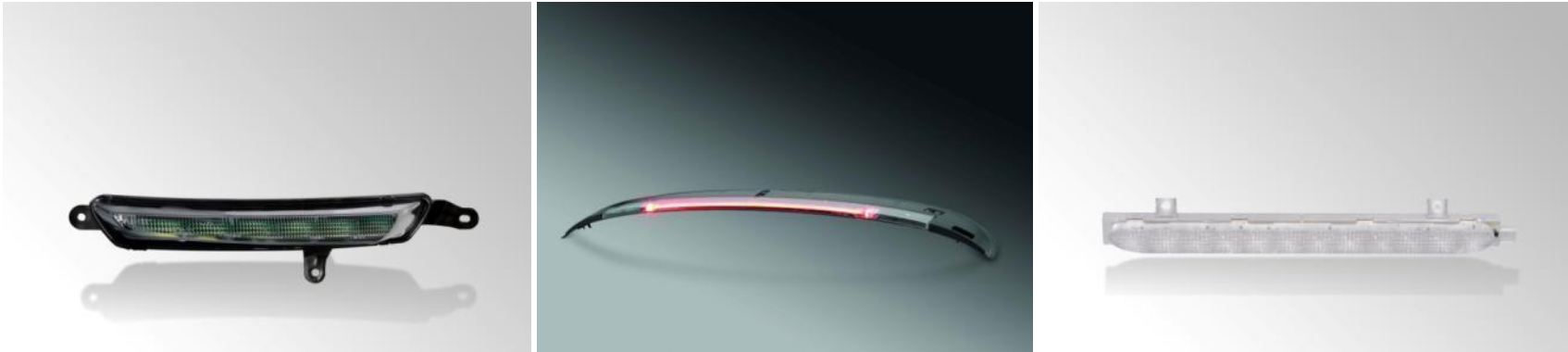


...with Micro Optics



- Customized application possibilities
- HELLA inhouse LED light source and optical system competence
- Independent from mirror manufacturer
- Cost efficient lamp construction with two plastic components possible

Small Lamps | Center High Mounted Stop Lamps (CHMSL)



Description

- Installation from inside or outside
- CHMSL can take up the styling of the rear lamp
- Optical systems for implementation
 - Fresnel lens
 - Taifoon lens
 - Direct reflector
 - Indirect reflector
 - Light guide
 - Micro optics

Advantages

- Increased warning effect due to fast reaction time of LED light source
- Cost effective solution with light guide (compared to Fresnel optics due to reduced amount of LEDs)
- Standard module for CHMSL available (housing customer specific)

Small Lamps | License Plate Lamps

DESCRIPTION	<ul style="list-style-type: none">• Sealed and non-sealed concepts• Competence to illumine the license plate homogeneously with a spot light source
VERSIONS	<ul style="list-style-type: none">• Versions with only one LED where<ul style="list-style-type: none">• Two compact lamps• Only one lamp with special optical systemillumine the license plate• Standard license plate lamps for multiple platforms as cost effective solution
ADVANTAGES	<ul style="list-style-type: none">• Low energy consumption with LED light source• Installation from inside due to long lifetime of the light source possible<ul style="list-style-type: none">• No special theft protection• Only lens visible• Simplified tightness concepts• Improved nighttime appearance due to light color of the LED



USP HELLA Lighting

L-LAB (Light laboratory)

- Results can be transferred directly into innovations
- Large competency fields due to open research in cooperation with public institutions (e.g. universities)
- Short distance to HELLA



Lighting tunnel

- Europe's largest light testing facility
 - Subjective impression can be gained under almost natural surroundings



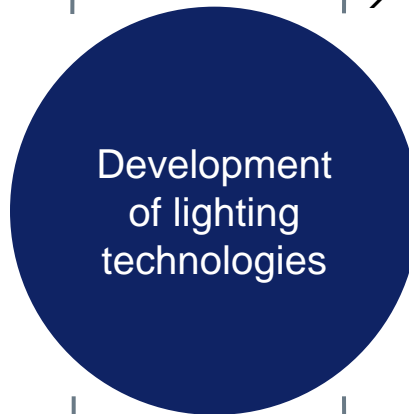
Member of Light.Sight.Safety

- A CLEPA initiative
- Promotion of life-saving assistance systems (e.g. Intelligent Lighting Systems)
 - Committed to inform the society and increase awareness of good quality car lighting



Inhouse styling department

- Inspiration
- Ideation
- Visualization



USP HELLA Lighting

Unique international Research Platform for Light Technologies

Partners of the L-LAB: Mutual transfer of knowledge

HELLA KGaA Hueck & Co.



University of Paderborn



University of Applied Science Hamm-Lippstadt



Research Network



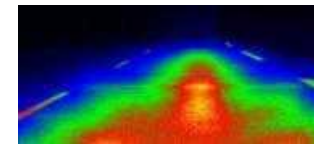
USP HELLA Lighting

Unique international Research Platform for Light Technologies

Research topics of the L-LAB

Mesopic vision

Measurement techniques
Effects of different light sources
Evaluation of headlamp light distributions



Active lighting

Sensor systems
Algorithm & data fusion



oLED

Long term and perception tests



Materials and optical design

Transparent silicone rubber
Primary optics and flexible lenses



Human-machine-interaction

Field tests, acceptance, safety



USP HELLA Lighting

Light Testing Facility | The largest of its kind in Europe

Light testing facility

- **Situated in Lippstadt**, the centerpiece of HELLA's technical competence
- The **140m long and 11m wide** facility gives an illuminating, realistic and subjective impression, complementing simulations and calculations
- Used to **test spread, light color, light distribution and the homogeneity of the light** when developing **for a customer** and also to test the **wide range of in-house developments**
- **Almost natural surroundings** can be created in this unique light testing facility



USP HELLA Lighting

Light.Sight.Safety | An Initiative of the Lighting Suppliers



“Good light = Good safety”

→ Coalition of several European automotive lighting companies

→ Targets

- To bring **technological advancements** to the automotive lighting market
- To communicate the **benefits** of **good vehicle lighting** to the market
- To improve **performance, comfort, safety** and **environmental friendliness** of car lighting
- To **increase awareness** and understanding of advantages of good quality car lighting **at end users, carmakers** and relevant decision-making authorities

