자동차용 LED 기술과 전망

2009.11.17
OSRAM-OS Korea 이주성

Roadmap for Automotive

- RCL & CHMSL
- Interior lighting
- HUD
- Ambient lighting
- CoD
- Infrared distance control
- Headlamp
- 2008 Infrared night-vision system

Opto Semiconductors
Why LED in Automotive?

- Small dimensions
- High shock resistance
- Long life time
- High color efficiency
- High Response speed
- Directional light

Main Applications in Automotive

**Exterior**
- Front:
  - Headlamp
  - Daytime running light
  - Turn signal
  - Fog lamp
- Rear:
  - RCL (rear combination lamp)
  - CHMSL (central high-mounted stop light)
  - Reverse
  - License plate lighting

**Interior**
- Cluster:
  - Meter BL
  - HuD
  - Info displays
  - CoD
- Ambient lighting:
  - CoD
  - Foot well
  - Reading lamp
- Center stack:
  - Car radio
  - Climate control
  - LCD BL
  - Switch & button

Opto Semiconductors
Global Automotive Market by Application (TAM in €)

Innovative Package Development

High Power LED Packages

- **TOLED®**: 3.5 x 2.8 x 1.9 mm
- **UltraFlux (PTH)**: 7.6 x 7.6 x 9.4 mm³
- **Golden DRAGON®**: 11.0 x 6.0 x 1.8 mm
- **Platinum DRAGON®**: 11.0 x 6.0 x 1.8 mm
- **Diamond DRAGON®**: 11.0 x 6.7 x 4.2 mm
- **Power TOLED®**: 3.5 x 2.8 x 1.9 mm
- **Power TOLED® with lens**: 3.5 x 2.8 x 3.6 mm
- **OSTAR®-Projection**: 28.0 x 15.0 mm
- **OSTAR®-Lighting**: 22.0 x 20.0 mm

*Dimensions: length x width x height*
Automotive Interior

Trend of carmaker to set their unique brand color
So far main drive comes from US car makers - first vehicles on the road today
However, European OEMs show strong interest
→ “clean” image of hybrid cars

Interior – Color On Demand

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OSRAM
Light Guides For Automotive

![Image of a car dashboard with light guides]

OOS Light Guides System: Target Applications

- **Meter Light Ring Illumination** (average 2 pcs/car)
- monochrome **Center Stack Displays**
- small monochrome **Dashboard Displays**

**OOS USP:**
offering full light guide system containing LEDs and light guides
**Interior – Displays**

- Trend of centralizing functional architectures from stand alone switches towards integration in displays (MMI, touch screens, navi)
- Mid term high utilization of displays in instrument clusters expected
- High interest to replace CCFL in mid size display backlighting (mercury free)

**Interior – Head Up Displays**

- Projection of driver information navigation,…
- Today only few car makers have HuDs in use
- Interest of market for HuDs in intermediate cars (monochrome colors)
Interior – Ambience / Dome Lighting

- Ambience Lighting for high passenger comfort
- Mood light – pick the color you are in to
- Often light guide designs
- Mainly standard products, also RGB

Automotive Exterior
Automotive Exterior Applications

Forward lighting
- Daytime Running Light
- Fog Lamp
- Position Light
- Adaptive Frontlighting System
- Front Turn Indicator
- Low Beam
- High Beam

Rear Combination Lamps
- Tail Light
- Rear Turn Indicator
- Rear Fog Light
- Back-up Light
- Stop Light

License Plate Lighting

PointLED®
- 0.725 mm

Advanced Power TOLED®
- 3.5 x 2.8 x 1.9 mm³

Lightguide

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RCL – Rear Combination Lamps with LED

Osram Power TOLED LAE67F

Puddle Lamp - Advanced Power TOPLED®

Advanced Power Topled LW G6SP

Power Topled L_W E6xx
Volkswagen Passat / Jetta / Bora RCL

Osram Opto LEDs:
- Power TOPLLED LA E67B
- MultiLED LAY T67B

Stop – Tail - Turn

US Cadillac CHMSL (with Osram Pointled)
Application: CHMSL / RCL

Bentley

Porsche Cayenne - RCL

BMW CS Concept

BMW 5 Series RCL

Application: Mirror Indicators

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Application: Front turn Indicator

LED-Headlamp suggested to use LED Front turn

Possible LEDs:
- Advanced PowerTopLED
- Golden Dragon
- Platinum Dragon

Golden Dragon  LY W57B

Exterior – Daytime Running Lamps

- Stylish light packages offered as option
- Energy saving, reduction of CO₂ emissions
- Major European OEMs have adopted LEDs for DRL/PO functions
Audi R8 DRL – Osram Power LED

Advanced Power Topled

LW G6xx-xxxx- (ECE)
LW G6xx-xxxx- (SAE)

12 LEDs / Side

RCL Stop / Tail: also with OOS PowerTopLED LA E65 and LA E67

Audi RS 6 Avant

SOP Audi: Oct 2007

Daytime Running Light

Golden Dragon LW W5SM-JXJZ-xxxx
10 LEDs / Side
Ferrari P4/5 by Pininfarina – Osram Power LED

DRL:
15 Lighting Clusters per side with
8 ThinGaN Power TopLEDs each to follow the contour of the vehicle body

(Osram Opto Press Release December 07th, 2006)

Requirements for Daytime Running Lamps

- Luminous Flux: ~ 160 lm – 180 lm initial value from the LED.
- Color: ECE white
  Corner points:  
  \[
  \begin{array}{cc}
  x & y \\
  0.310 & 0.348 \\
  0.310 & 0.283 \\
  0.443 & 0.382 \\
  0.500 & 0.382 \\
  0.500 & 0.440 \\
  0.453 & 0.440 \\
  \end{array}
  \]
- Life Time: Up to 10,000 hours with a max. degradation to 70% of the initial value.
- Ambient Temperature: Continuous up to 110°C with higher peak temperatures.
- Minimum Illuminating surface: 25 square cm
### Characteristics of LWG6CP

**Features**
- **package**: white P4-LCC-6 package, clear silicone resin
- **feature of the device**: very low thermal resistance, high optical power

**color coordinates**: $x = 0.34, y = 0.34$ acc. to CIE 1931 (white)

**typ. color temperature**: 5600 K
**color reproduction index**: 80
**viewing angle**: Lambertian Emitter (120°)
**technology**: ThinSAP®
**optical efficiency**: 43 lm/W
**grouping parameter**: luminous intensity, color coordinates, forward voltage
**assembly methods**: suitable for all SMT assembly methods
**soldering methods**: IR reflow soldering
**preconditioning**: acc. to JEDEC Level 2
**taping**: 12 mm tape with 1000/reel, ø 180 mm

**ESD-withstand voltage**: up to 2 kV acc. to JESD22-A114-D

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### LW G6CP

**Maximum Ratings**

<table>
<thead>
<tr>
<th>Bezeichnung Parameter</th>
<th>Symbol</th>
<th>Wert Value</th>
<th>Einheit Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betriebstemperatur Operating temperature range</td>
<td>$T_{op}$</td>
<td>$-40 \ldots +125$</td>
<td>°C</td>
</tr>
<tr>
<td>Lagertemperatur Storage temperature range</td>
<td>$T_{sta}$</td>
<td>$-40 \ldots +125$</td>
<td>°C</td>
</tr>
<tr>
<td>Sperrschichtstemperatur Junction temperature</td>
<td>$T_j$</td>
<td>&gt;150 for short term applications</td>
<td>°C</td>
</tr>
<tr>
<td>Durchlassstrom Forward current ($T_J=25°C$)</td>
<td>($I_F$)</td>
<td>30</td>
<td>mA</td>
</tr>
<tr>
<td>(max.)</td>
<td>($I_{LF}$)</td>
<td>250</td>
<td>mA</td>
</tr>
<tr>
<td>Stoßstrom Surge current ($t \leq 10 \mu{s}, T_J=25°C$)</td>
<td>$I_{RM}$</td>
<td>750</td>
<td>mA</td>
</tr>
<tr>
<td>Sperrspannung Reverse voltage ($T_J=25°C$)</td>
<td>$V_R$</td>
<td>not designed for reverse operation</td>
<td>V</td>
</tr>
<tr>
<td>Leistungsaufnahme Power consumption ($T_J=25°C$)</td>
<td>$P_{tot}$</td>
<td>1075</td>
<td>mW</td>
</tr>
<tr>
<td>Wärmewiderstand Thermal resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sperrschicht/Umgebung* ($T_{amb}=17°C$) Junction/ambient*</td>
<td>$R_{Th,JA}$</td>
<td>90</td>
<td>kW</td>
</tr>
<tr>
<td>Sperrschicht/Leitstand Junction/solder point</td>
<td>$R_{Th,JC}$</td>
<td>40</td>
<td>kW</td>
</tr>
</tbody>
</table>
LW G6CP

Characteristics of LWG6CP

APT (Chip-Level-Conversion):
LW G6CP-DAEA-7K8K (ECE)
LW G6CP-DBEA-7K8K (SAE)
12 LEDs / Side

Audi SOP Jan 2007

Applications – Head Lamp

OSTAR®-Headlamp – the premium class for automobile applications.
Automotive exterior

• Headlamp: high beam, low beam, fog lamp
• Daytime running light
• Adaptive front lighting system
### Technical Details

<table>
<thead>
<tr>
<th></th>
<th>LE W D1A</th>
<th>LE UW D1W</th>
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</thead>
<tbody>
<tr>
<td>Grouping Current</td>
<td>700 mA</td>
<td>700 mA</td>
</tr>
<tr>
<td>Max. Forward Current</td>
<td>1000 mA</td>
<td>1000 mA</td>
</tr>
<tr>
<td>Typ. Forward Voltage</td>
<td>18.5 V</td>
<td>18.5 V</td>
</tr>
<tr>
<td>Typ. Power Consumption</td>
<td>13 W</td>
<td>13 W</td>
</tr>
<tr>
<td>Typ. Thermal Resistance RthJB</td>
<td>3 K/W</td>
<td>3 K/W</td>
</tr>
<tr>
<td>Max. Thermal Resistance RthJB</td>
<td>3.7 K/W</td>
<td>3.7 K/W</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>145º C</td>
<td>150º C</td>
</tr>
</tbody>
</table>

### Products

<table>
<thead>
<tr>
<th></th>
<th>LE W D1A</th>
<th>LE UW D1W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Silicone Encapsulation</td>
<td>Glass Window Cover</td>
</tr>
<tr>
<td>Color</td>
<td>SAE-/ECE-White</td>
<td>SAE-/ECE-White</td>
</tr>
<tr>
<td>Typ. Brightness</td>
<td>280 lm @ 700 mA</td>
<td>550 lm @ 700 mA</td>
</tr>
<tr>
<td>Max. Brightness</td>
<td>420 lm @ 700 mA</td>
<td>650 lm @ 700 mA</td>
</tr>
<tr>
<td>Mass production</td>
<td>Running</td>
<td>End of 2008</td>
</tr>
<tr>
<td>AEC-Q101</td>
<td>Automotive Qualified</td>
<td>Automotive Qualified</td>
</tr>
</tbody>
</table>
Primary Optics Status

- primary optic designed for air gap between chip and optic
- prepares beam pattern for projector systems
- Possible application could be fog lamp

- First samples build up
  Wall distance 25m
  Luminous flux 265lm/400lm
  max. illumination 40 lx
- Highly focused beam pattern with maximum at cut-off