Opto Semiconductors

Light-emitting diodes (LED) are found in a growing number of general lighting applications. OSRAM Opto Semiconductors offers a wide range of solutions – from single LED through to LED modules.
Innovative light-emitting diodes are compound semiconductors that convert electric current direct into light. Just a few millimeters in size, these LED offer decisive advantages through their advanced technology, making them a real alternative to conventional lamps in many applications.

**TECHNOLOGICAL ADVANTAGES**

- high color efficiency
- extremely long life
- negligible early failures
- small dimensions
- high resistance to shock and vibration
- directed radiation characteristic
- no IR/UV radiation
- low power consumption and heat generation

**USER BENEFITS**

- creative design possibilities for innovative light solutions through the color variety of LED, their compactness and flexible modularization
- economically attractive through low power consumption, long life and minimum maintenance
- maximum safety through excellent reliability, even in difficult operating conditions.
OSRAM Opto Semiconductors GmbH & Co. OHG (OSRAM OS),
launched on 1 January 1999,
is a joint venture between
OSRAM GmbH and Infineon
Technologies AG to continue
Siemens activities in the field
of optoelectronic semiconduc-
tors. OSRAM GmbH holds a
majority 51% share in the
venture and exercises execu-
tive management. OSRAM OS
offers its customers semi-
conductor-based solutions for
lighting, sensor engineering
and visualization. It merges
the competence of two world-
ranking enterprises: OSRAM
GmbH is one of the three
leading lamp manufacturers
worldwide, while Infineon
ranks among the ten biggest
semiconductor producers.

Pointing ahead:
COINlights not only make
it safer for people to find their
way about but also set new
design accents

SINGLE-SOURCED
COMPETENCE

OSRAM Opto
Semiconductors offers the
core competence needed for
LED lamp module produc-
tion – from discrete compo-
nents through electrical,
thermal and optical design
to complex modules.

COMPLETE SYSTEMS
ENGINEERING

Our solutions come
complete with the matching
power supplies.
Connectors are available
for all modules, developed
in cooperation with the
specialists of BJB, Arnsberg.

CREATIVE LIGHT SOLUTIONS
FOR ALL KINDS
OF APPLICATIONS

LED and LED modules from
OSRAM Opto Semiconductors
are the ideal basis for creative
design-ins and new light
solutions in a wide range of
applications:

- colored light of your choice –
  LED emit yellow, orange, red,
  blue, green and white
- colored light with plexiglass
  for highly decorative effects
- can be adapted to complex
  structures – eg backlighting
  of letters – through compact,
  flexible modules
- extremely low-profile light
  solutions
- reliable orientation lighting
  that is easy to install and
  integrates perfectly in the
  existing architecture
- economical operation through
  low power consumption
- reliable outdoor operation
  through mechanical rugged-
  ness in a wide range of
  operating temperatures
- ideal for powering by solar
  energy through minimum
  consumption and low forward
  voltage

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TRULY ILLUMINATING:
LED MODULES FROM OSRAM OS

LED modules from OSRAM Opto Semiconductors consist of a certain number of LED with integrated passive or active current regulation. The single LED are mounted on either rigid or flexible printed circuit boards. Secondary optical elements such as lenses, reflectors and surface light guides can be added for enhanced performance.

POSSIBILITIES TODAY AND TOMORROW

OSRAM OS produces a high-performance selection of fully contained LED modules – power-saving and cost-saving – for a wide range of conventional and emerging uses in general lighting.

THREE FAMILIES — VERSATILE AND FLEXIBLE

- LED modules without lens system
  - LINEARlight
  - LINEARlight Flex
  - BACKlight
  - COINlight
- LED modules with lens system
  - EFFECTlight
- LED modules with light guides
  - MARKERlight
  (rectangular, square, round)

Light brought into shape: BACKlight

Color accents for everyday gray: EFFECTlight
ELECTRICAL DESIGN OF MODULES

In electrical terms, LED are semiconductor diodes. Their major electrical characteristics are:
- Forward voltage \( U_F \)
- Forward current \( I_F \)

To ensure long life, the specified forward current should not be exceeded.

Modules from OSRAM OS exhibit the following features:
- series connection of LED
- combined with passive and active current limiting
- operation on 10 V DC and 24 V DC
- easy operation with OPTOTRONIC power supply
**FLEXIBLE LIGHT**

**PIECE BY PIECE:**

**LINEARlight**

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**LINEARlight**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>color</td>
<td>red</td>
<td>yellow</td>
<td>green</td>
<td>blue</td>
<td>white</td>
</tr>
<tr>
<td>luminous intensity/LED</td>
<td>500 (mcd)</td>
<td>500 (mcd)</td>
<td>330 (mcd)</td>
<td>80 (mcd)</td>
<td>420 (mcd)</td>
</tr>
<tr>
<td>I_l (typ.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED per module</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>wavelength λ (typ.)</td>
<td>617 nm</td>
<td>587 nm</td>
<td>525 nm</td>
<td>470 nm</td>
<td>X = 0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y = 0.31</td>
</tr>
<tr>
<td>electrical data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_op; I_op; P</td>
<td>10 V_e; 0.4 A; 4 W</td>
<td>10 V_e; 0.32 A; 3.2 W</td>
<td>10 V_e; 0.4 A; 4 W</td>
<td>10 V_e; 0.4 A; 4 W</td>
<td>10 V_e; 0.32 A; 3.2 W</td>
</tr>
<tr>
<td>other data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>basic dimensions (l x w):</td>
<td>overall module 448 x 10 mm;</td>
<td>smallest unit with 4 LED approx. 56 x 10 mm;</td>
<td>emission angle (FWHM): 120°;</td>
<td>operating temperature: -30 to +65 °C</td>
<td></td>
</tr>
</tbody>
</table>

---

**Applications**

- general-purpose
- for edgelighting of transparent and diffuse materials
- for lifesaving/rescue sign lights and commercial signs
- for marking paths and contours (eg escape routes, borders and stairs)

---

**SPECIAL FEATURES**

- module on printed circuit board
- high luminous efficiency through OSRAM Power TOPOLED®
- low heat generation
- low profile (< 5 mm) for flat surface and recessed mounting
- separable into smallest unit without degrading performance of remaining board
- straightforward handling through LED Connect System (BJB)
- simplified operation with OPTOTRONIC power supply
- series or parallel connection
- available in red, yellow, green, blue and white
- new design allows up to 25 m lines with a single power input (module available from mid-2001)
NEW ROLE FOR INNOVATIVE LIGHT: LINEARlight FLEX (TapeLED)

SPECIAL FEATURES

- Module on flexible printed circuit board
- High luminous efficacy through OSRAM Power TOPLED® or OSRAM SIDELED®
- Light directed to top (TOPLED®) or to side (SIDELED®)
- Connection possible to LED Connect System (BJB) by solder pads
- Low heat generation
- Low-profile OSRAM TOPLED® (< 5 mm) for flat surface and recessed mounting
- Separable into smallest unit without degrading performance of remaining board
- Simplified operation with OPTOTRONIC power supply
- Flexible three-dimensional assembly possible
- Available in red, yellow, green, blue and white
- Simplicity of installation through adhesive tape on rear of module
- Series production from mid-2001

Applications

- General-purpose
- For edgelighting transparent and diffuse materials
- For lifesaving/rescue sign lights and commercial signs
- For marking paths and contours (eg escape routes, borders and stairs)
- For precise backlighting of complex contours

datasheet available
Applications

- for backlighting of signs and channel letters
- for multiple uses in general lighting

Special features

- module on printed circuit board
- high luminous efficacy through OSRAM Power TOLED®
- low heat generation
- low profile (< 5 mm) for flat surface and recessed mounting
- flexible three-dimensional assembly enabled by cable connection
- separable into any number of boards
- straightforward handling through LED Connect System (BJB)
- damp-proof connectors (IP 65)
- homogeneous light characteristic from 2.5 cm inserted depth
- simplified operation with OPTOTRONIC power supply
- available in red, orange, yellow, green, blue and white
- holes in boards for simple assembly with screws or snap fasteners
- series and parallel connection of module strings

BACKlight

<table>
<thead>
<tr>
<th>available module types</th>
<th>OS-LM03A-A</th>
<th>OS-LM03A-O*</th>
<th>OS-LM03A-Y</th>
<th>OS-LM03A-T</th>
<th>OS-LM03A-B</th>
<th>OS-LM03A-W</th>
</tr>
</thead>
<tbody>
<tr>
<td>color</td>
<td>red</td>
<td>orange</td>
<td>yellow</td>
<td>green</td>
<td>blue</td>
<td>white</td>
</tr>
<tr>
<td>luminous intensity/LED</td>
<td>I₀ (mcd) (typ.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>400</td>
<td>500</td>
<td>330</td>
<td>80</td>
<td>420</td>
</tr>
<tr>
<td>LED per module</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>wavelength λ (typ.)</td>
<td>617 nm</td>
<td>610 nm</td>
<td>587 nm</td>
<td>525 nm</td>
<td>470 nm</td>
<td>X = 0.32; Y = 0.31</td>
</tr>
<tr>
<td>electrical data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vₘₜ; Iₚₜ; Pₜ</td>
<td>10 Vₑ; 0.4 A; 4 W</td>
<td>10 Vₑ; 0.32 A; 3.2 W</td>
<td>10 Vₑ; 0.32 A; 3.2 W</td>
<td>10 Vₑ; 0.32 A; 3.2 W</td>
<td>10 Vₑ; 0.32 A; 3.2 W</td>
<td>10 Vₑ; 0.32 A; 3.2 W</td>
</tr>
</tbody>
</table>

For all module types
**SPECIAL FEATURES**

- high luminous efficacy through OSRAM SIDELED® and OSRAM Power TOPLED®
- different modules with 8, 9 or 12 LED, emission angle 120° per LED
- low profile (< 10 mm) for recessing
- simplified operation with OPTOTRONIC power supply
- available in red, yellow, green, blue and white
- connection to LED Connect System (BBJ) by terminal screw on rear

**Applications**

- light source for marking (e.g. path and escape routes)
- recessed wall lights
- recessed floor lights

---

**COINlight**

<table>
<thead>
<tr>
<th>available module types shape</th>
<th>OS-CM01B-x</th>
<th>OS-CM01C-x</th>
<th>OS-CM01E-x</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LED type</strong></td>
<td>SIDELED</td>
<td>SIDELED</td>
<td>Power TOPLED</td>
</tr>
<tr>
<td><strong>LED per module</strong></td>
<td>8</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td><strong>electrical data V_{in}</strong></td>
<td>24 V_{in}</td>
<td>24 V_{in}</td>
<td>24 V_{in}</td>
</tr>
<tr>
<td><strong>electrical data I_{op}; P_{V}</strong></td>
<td>depending on module type and color; range: 0.02 to 0.06 A; 0.5 to 1.5 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>luminous intensity/LED I_{(mcd)}</strong></td>
<td>depending on module type and color; refer to data sheet</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>emission colors x</strong></td>
<td>all module types are available in the following colors: red (615 nm) - A, yellow (587 nm) - Y, green (525 nm) - T, blue (470 nm) - B, white (X = 0.32, Y = 0.31) - W</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>other data</strong></td>
<td>emission angle (FWHM): 120°; operating temperature: -30 to +65 °C; overall module diameter: 32.5 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Dimensions in mm**

![Dimensions of COINlight](images/dimensions.png)

**COINlight available module types**

- **OS-CM01B-x**: round
- **OS-CM01C-x**: round
- **OS-CM01E-x**: round

---

**Applications**

- light source for marking (e.g. path and escape routes)
- recessed wall lights
- recessed floor lights

---

**Datasheet available**
COLOR ACCENTS FOR EVERYDAY GRAY: EFFECTlight

SPECIAL FEATURES
- module with preceding lens
- high luminous efficiency through Power TOPLED® with lens
- extremely narrow emission angle of approx. 4°
- series connection of up to 14 modules
- minimum heat generation
- straightforward handling through LED Connect System (BJB)
- simplified operation with OPTOTRONIC power supply
- available in red, yellow, verde and blue

Applications
- architectural effect lighting in and on buildings
- light effects for pillars, columns and arches
- strip illumination
- general purpose signals
- small beam
- very easily combined with follow-up lenses

COLOR ACCENTS FOR EVERYDAY GRAY:
EFFECTlight

EFFECTlight

<table>
<thead>
<tr>
<th>available module types</th>
<th>OS-WL01A-A</th>
<th>OS-WL01A-Y</th>
<th>OS-WL01A-V</th>
<th>OS-WL01A-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>color</td>
<td>red</td>
<td>yellow</td>
<td>verde</td>
<td>blue</td>
</tr>
<tr>
<td>luminous intensity/module $I_v$ (cd) (typ.)</td>
<td>1000</td>
<td>1000</td>
<td>750</td>
<td>500</td>
</tr>
<tr>
<td>LED per module</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>wavelength $\lambda$ (typ.)</td>
<td>615 nm</td>
<td>587 nm</td>
<td>505 nm</td>
<td>470 nm</td>
</tr>
<tr>
<td>electrical data $V_{oc}$; $I_{oc}$; $P_r$</td>
<td>24 Vcc; 50 mA; 1.2 W</td>
<td>24 Vcc; 40 mA; 0.96 W</td>
<td>24 Vcc; 50 mA; 1.2 W</td>
<td>24 Vcc; 50 mA; 1.2 W</td>
</tr>
<tr>
<td>other data</td>
<td>LED configuration per module: 5 x 2 Power TOPLED with lens; emission angle (FWHM): 4°; operating temperature: -30 to +65°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for all module types</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Datasheet available
Low-profile solutions show the way: MARKERlight

### Applications
- Orientation and information lighting (e.g., routes and steps, seating in theaters and cinemas)
- Backlighting of numbers, letters, or symbols (e.g., number, door, and name plates)
- Recessed wall lights
- Designer lighting for furniture and ambiance
- Stop-and-go lights

### Special Features
- Modules in different shapes and sizes with light guides
- High luminous efficiency through OSRAM Hyper SIDELED®
- Homogeneously illuminated surfaces
- Low heat generation
- Low profile for flat surface and recessed mounting
- Bicolor module available

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### MARKERlight

**available module types**

<table>
<thead>
<tr>
<th>shape</th>
<th>OS-ML01A-x</th>
<th>OS-ML01B-x</th>
<th>OS-ML01C-x</th>
<th>OS-ML02A-x</th>
<th>OS-ML03A-x</th>
</tr>
</thead>
<tbody>
<tr>
<td>rectangular, small</td>
<td>85 x 37 x 6.7</td>
<td>112.5 x 48 x 6.7</td>
<td>140 x 59 x 6.7</td>
<td>85 x 85 x 6.7</td>
<td>Ø 110 x 6.7</td>
</tr>
<tr>
<td>rectangular, medium</td>
<td>52 x 22</td>
<td>79.5 x 33</td>
<td>107 x 44</td>
<td>52 x 52</td>
<td>Ø 77</td>
</tr>
<tr>
<td>rectangular, large</td>
<td>120 x 59 x 6.7</td>
<td>107 x 44</td>
<td>160 x 60 x 6.7</td>
<td>107 x 52</td>
<td>Ø 110 x 6.7</td>
</tr>
<tr>
<td>square</td>
<td>85 x 85 x 6.7</td>
<td>85 x 85 x 6.7</td>
<td>85 x 85 x 6.7</td>
<td>Ø 110 x 6.7</td>
<td>Ø 110 x 6.7</td>
</tr>
<tr>
<td>circular</td>
<td>Ø 110 x 6.7</td>
<td>Ø 110 x 6.7</td>
<td>Ø 110 x 6.7</td>
<td>Ø 110 x 6.7</td>
<td>Ø 110 x 6.7</td>
</tr>
</tbody>
</table>

**Electrical data**

<table>
<thead>
<tr>
<th>LED per module</th>
<th>electrical data</th>
<th>electrical data</th>
<th>luminance</th>
<th>emission colors x</th>
<th>other data</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>10 V_e</td>
<td>10 V_e</td>
<td>L_e (cd/m²)</td>
<td>depending on module type and color; range: 40 to 80 mA; 0.4 to 3.84 W</td>
<td>Operating temperature: -30 to +65°C</td>
</tr>
<tr>
<td>12</td>
<td>10 V_e</td>
<td>10 V_e</td>
<td>L_e (cd/m²)</td>
<td>depending on module type and color; range: 80 to 1260</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>10 V_e</td>
<td>10 V_e</td>
<td>L_e (cd/m²)</td>
<td>depending on module type and color; range: 40 to 80 mA; 0.4 to 3.84 W</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>24 V_e</td>
<td>24 V_e</td>
<td>L_e (cd/m²)</td>
<td>depending on module type and color; range: 80 to 1260</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>24 V_e</td>
<td>24 V_e</td>
<td>L_e (cd/m²)</td>
<td>depending on module type and color; range: 40 to 80 mA; 0.4 to 3.84 W</td>
<td></td>
</tr>
</tbody>
</table>

### Dimensions in mm

- Dimensions in mm (l x w x h)
- Dimensions in mm (l x w, l x w)
- Dimensions in mm (l x w, l x w)
- Dimensions in mm (l x w, l x w)

### Datasheet Available

Datasheet available
OSRAM Opto Semiconductors offers you more than first-class LED and LED modules. You no longer have to spend your time looking for any extra components you need. Instead you can focus on what is essential for you: your product and your business.

In addition to LED modules we deliver optimized power supplies. Matching connectors have been developed in cooperation with BJB, Arnsberg (Germany).

**LED connect system**
- connectors for simple, safe and speedy links with no need for tools
- connections between power supplies and modules as well as between individual modules
- non-interchangeable connections to eliminate production defects
- technology matched to LED modules for high functionality

**YOUR DIRECT LINE TO OUR CONNECT SYSTEM PARTNER**

BJB GmbH & Co. KG
POB 1380
D-59703 Arnsberg (Neheim)
Phone: +49-2932-982-0
Fax: +49-2932-982-8201
info@bjb.de
www.bjb.de
OPTOTRONIC POWER SUPPLY

- electronically stabilized, load-insensitive DC output voltage
- shortcircuit-proof and overload protected
- designed and built to all applicable standards
- OT 12/230-240/10 and OT 20/230-240/24 are economical tabletop models for the European market and Australia
- OT 06/100-240/10 COS and OT 06/100-240/24 COS are 6 W power supplies in a specially constructed package; very small for incorporation in conventional flush-mounted boxes, suitable for inclusion in furniture, for worldwide use
- further power categories and packages in planning

<table>
<thead>
<tr>
<th>Available Types</th>
<th>OT 12/230-240/10</th>
<th>OT 20/230-240/24</th>
<th>OT 06/100-240/10 COS</th>
<th>OT 06/100-240/24 COS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>230 to 240 V</td>
<td>230 to 240 V</td>
<td>100 to 240 V</td>
<td>100 to 240 V</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>10 V&lt;sub&gt;d&lt;/sub&gt;</td>
<td>24 V&lt;sub&gt;d&lt;/sub&gt;</td>
<td>10 V&lt;sub&gt;d&lt;/sub&gt;</td>
<td>24 V&lt;sub&gt;d&lt;/sub&gt;</td>
</tr>
<tr>
<td>Max. Output Power</td>
<td>12 W</td>
<td>20 W</td>
<td>6 W</td>
<td>6 W</td>
</tr>
<tr>
<td>Size in mm (l x w x h)</td>
<td>109 x 50 x 35</td>
<td>109 x 50 x 35</td>
<td>dia. 55 x 19</td>
<td>dia. 55 x 19</td>
</tr>
</tbody>
</table>

Standards and regulations

In the case of LED and LED modules, there are regulations for protection of the human eye against excessive doses of radiation. These are based on the tolerances issued by the ICNRP. OSRAM Opto Semiconductors can submit certification by an accredited test laboratory for all standard modules.

The stipulations of the low voltage directive are not applicable to LED modules because of their operating voltage of 10 or 24 V DC. LED modules do not produce any interference in the context of EMC.

The major directives for eye safety:
1. IEC 60825-1 A2: Safety of Laser Devices
2. ANSI IESNA RP – 27.1 to 27.3
3. ACGIH (American Conference of Governmental Industrial Hygienists)
4. CIE TC 6-47 Photobiological Safety of Lamps and Lamp Systems
**HOW DOES AN LED WORK?**

A light-emitting diode consists of several layers of semiconductor material. When the diode is forward biased, light is generated in a thin layer, the so-called active layer. Unlike incandescent lamps, which radiate a continuous spectrum, an LED emits an almost monochromatic light of a particular color. The color of the light depends on the material used. Two material systems – AlInGaP and InGaN – are used for creating high brightness LED in all colors from blue through red and also in white (luminescence conversion).

The efficiency of LED has very much improved in the last few years, and has already reached levels of 30lm/W and more – depending on the color. This is the result of high-quality production and advanced technologies.

**LED PACKAGES**

The typical size of an LED is approx. a few hundred micrometers. The semiconductor is mounted in a package for easy electrical contact and environmental protection. There are two basic types of package:

- **THT (through-hole technology)**
- **SMT (surface-mount technology)**

**ELECTRICAL DATA**

The highest luminosity is produced with a DC voltage source. The necessary forward voltage depends on the color of the LED light, varying between 2 and 4 V at forward current up to 70mA.

**TEMPERATURE RESPONSE**

The optical output power drops as temperature increases. Temperature dependence is more significant in yellow LED than in green ones. This drop in power as a function of temperature can be reversed and has nothing to do with degradation. The maximum operating temperature for LED is normally 100 °C, and this should not be exceeded.

**LIFETIME AND DEGRADATION**

Just like a conventional source of light, the intensity of LED light gradually diminishes in the course of time. When an LED produces 50% of its original luminous efficiency, it has, by definition, reached the end of its life.

Under reasonable operating conditions, LED can last up to 100,000 hours.

**GLOSSARY**

- forward voltage typically 2 to 4 V
- forward current typically 10 to 70 mA
- color range 460 to 650 nm (dominant wavelength)
- emission angle 15 to 120°
- temperature range -40 to +100°C
THE FUTURE

**THT package:**
This kind of package is soldered “through holes” to the circuit board. The commonest type is the radial 5 mm package. The LED chip is seated in the reflector, which is connected to the cathode lead. A bond wire establishes electrical contact to the anode. The light is emitted by a lens integrated into the package. Different radiation characteristics are produced as a function of chip-to-lens spacing and the shape of the lens.

**SMT package:**
This modern design consists of a plastic package that also serves as the reflector. The LED chip is seated in the cavity. This cavity is filled with epoxy resin to improve coupling out of the light and protect the chip against environmental influences. SMT components can be assembled faster and with better quality than THT components.

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**LED packages for general lighting applications**

**LED package**

**Radial**
- T1 (3 mm), T1 3/4 (5 mm)
- THT package
- various radiation angles
- clear or diffuse

**Applications**
- for various applications eg displays, indicators

**Hyper SIDELED®**
- SMT package
- radiation angle 120°
- integrated reflector
- radiation parallel to board, thus ideal for coupling into light guides
- available in all colors

**Applications**
- marking, backlighting, designer lights, recessed lights

**Power TOPELED®**
- SMT package
- radiation angle 120°
- integrated reflector
- high luminous efficacy
- low thermal resistance
- available in all colors

**Applications**
- backlighting, marking, recessed lights

**Power TOPELED® with lens**
- SMT with integrated lens
- radiation angle 60°
- integrated reflector
- high luminous efficacy
- low thermal resistance
- available in all colors

**Applications**
- effect lighting, small beams

**Secondary optical elements**

**Lens 4°**
- very narrow radiation angle
- high intensity on axis
- application in effect lighting

We also design lenses with homogeneous light distribution and radiation angles between 10° and 20°.

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**Color spectrum of different LED**

- InGaN blue
- verde
- green
- yellow
- red
- hyper red