Golden DRAGON® Plus

Application Note

Abstract

This application note provides an insight into the Golden DRAGON® Plus, a high power LED from the DRAGON® product family of OSRAM Opto Semiconductors.
A fundamental overview of the construction, handling and processing of the new Golden DRAGON® Plus is presented. In addition, general information concerning thermal characteristics, influence of junction temperature, reliability and lifetime is provided.

Golden DRAGON® Plus

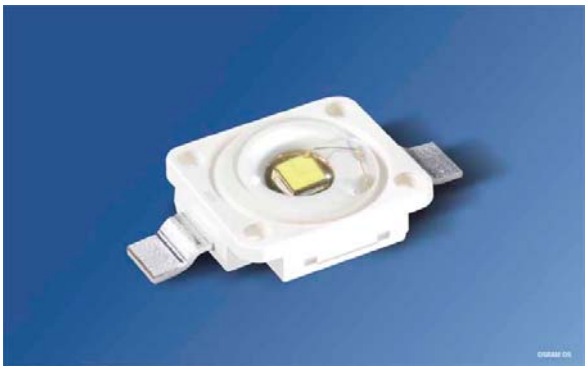
The Golden DRAGON® Plus is a further development of the standard Golden DRAGON® LED with optimized light coupling and improved lifetime.

Above all, the Golden DRAGON® Plus is predestined for use in applications in which high brightness and low space requirements are necessary along with a long lifetime.

It is especially well suited for application areas in lighting technology:

General Lighting

- Indoor and outdoor lighting
- Stage lighting
- Architectural illumination, e.g. facade lighting, stairways lighting
- Glass cabinet lighting
- Spotlights
- Reading lamps
- Effect and accent lighting, e.g. display cases, furniture illumination, marker lights
- Street & tunnel lighting



Industry and signs

- Emergency lighting
- Warning lights e.g. road works, light house, buoys
- Video walls on building facades
- Signal and symbol luminaire

Specialty lighting

- Flashlights
- Bicycle headlamps
- Security lights

Currently, the Golden DRAGON® Plus is available in various shades of white, from Ultra White and White to Warm White.

LED Type	Color	Color Temperatur
LUW W5AM	Ultra White	5700 – 6500K
LW W5AM	White	5000 – 5700K
LCW W5AM	Warm White	2700 – 4200K

Table 1: The various white variants of the Golden DRAGON® Plus

The precise description of the available chromaticity coordinate groups can be found at the data sheets of the LED types.

Construction and Features

As with all LEDs of the product family, the Golden DRAGON® Plus is based on the same thermally optimized package design – consisting of a prefabricated plastic housing with an integrated heatsink and connection contacts.

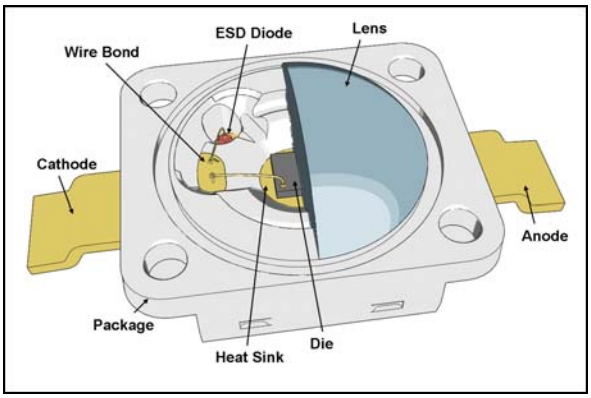


Figure 1: Internal construction of the Golden DRAGON® Plus

With a common design base, mutual exchangability is achieved throughout the DRAGON® family. At the same time, the customer has more flexibility due to the identical solder pad layout.

With one circuit board layout, for example, several applications with different brightness requirements can be implemented.

As the centerpiece and actual light source of the Golden DRAGON® Plus, highly efficient semiconductor chips of the latest ThinGaN® thin film technology from OSRAM Opto Semiconductors are employed.
In addition to high efficiency, the ThinGaN® technology has the distinct advantage that the chip is nearly a pure surface emitter.
For the white variants of the Golden DRAGON® Plus, this means that the wavelength conversion for creation of white light can be carried out directly at the chip level.
The converter material is applied directly to the chip surface in the form of a chip coating.
This has the advantage that the converter layer can be applied with a homogeneous thickness and in a uniform concentration. Thus, the converted light is nearly constant across the entire chip surface, allowing a uniform white light to be achieved.

In order to guarantee optimal heat dissipation of the housing, the semiconductor chip is mounted directly on the heatsink.
In this way, the Golden DRAGON® Plus yields a maximum thermal resistance of 11 K/W.

In contrast to the standard Golden DRAGON®, the silicone encapsulant of the DRAGON® Plus is formed into a lens.
The Golden DRAGON® Plus silicone lens serves as a cost efficient device to optimize efficiency, by allowing most of the generated light to directly leave the LED.
The lens is not intended to serve as a high precision optical element, due to its inherently larger variations in lens shape (95% tolerance).
In many applications such as backlighting and general illumination with not too narrow spots, the lens shape tolerances will not have any noticeable influence.
However, in some applications where extremely precise specifications apply to the desired radiation pattern (such as low beam in automotive headlamps or highly collimated spotlights), special care must be taken by the illumination system designer to ensure that the application meets its specifications, taking the lens shape tolerances into account.

Due to the cast lens, the intensity distribution of the Golden DRAGON® Plus is somewhat wider than the familiar Lambertian cosine pattern of flat, diffuse light sources like the standard Golden DRAGON®.
In a Lambertian intensity distribution, 50% of the emitted flux lies within an angular range of +/-45°; the remaining 50% lies outside this range. In comparison, approximately 60% of the emitted flux of the Golden DRAGON® Plus is directed towards angles larger than 45°.

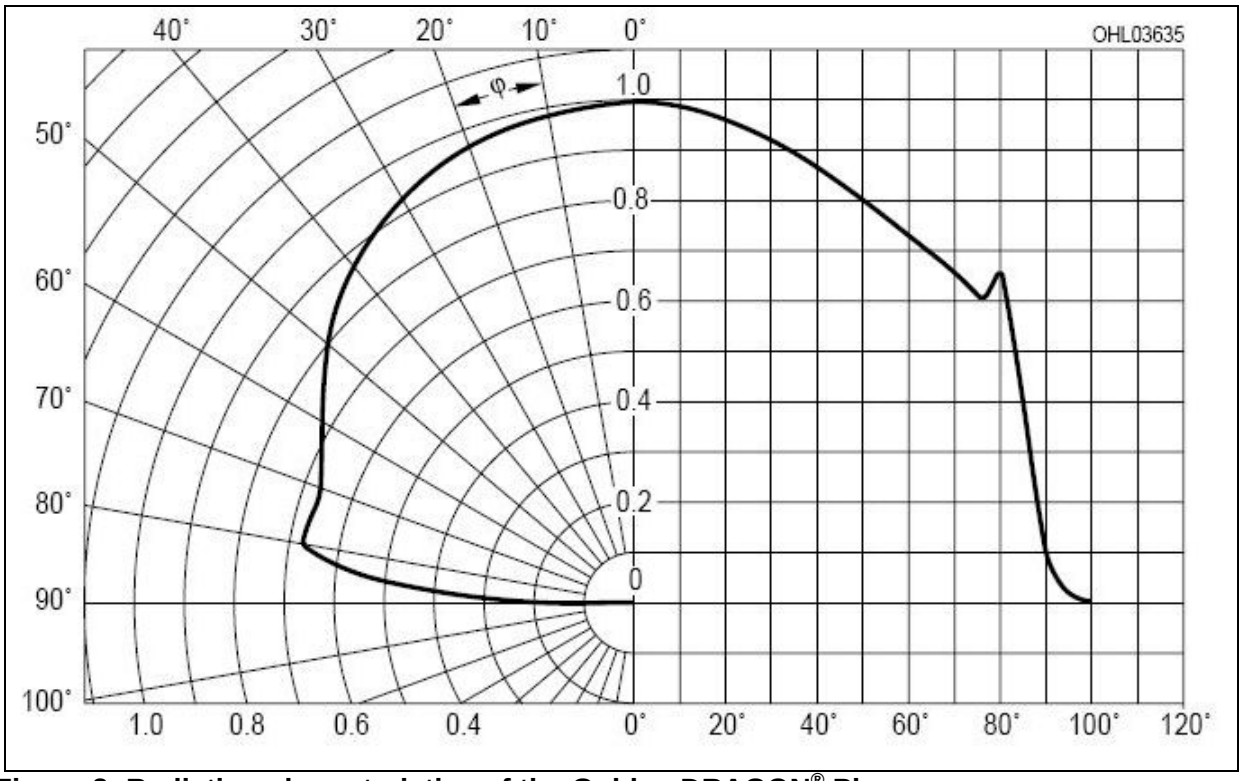


Figure 2: Radiation characteristics of the Golden DRAGON® Plus

For applications using lateral reflectors, the Golden DRAGON® Plus will lead to a more efficient system than the standard Golden DRAGON®.

The radiation characteristics of the Golden DRAGON® Plus are shown in Figure 2.

As with all other LEDs from OSRAM OS, the Golden DRAGON® Plus fulfills the applicable RoHS guidelines, and contains no lead or other hazardous substances.

Handling

Due to the elastic properties of the silicone encapsulant, mechanical stress during processing must be reduced or eliminated to the greatest extent possible (see also application note “Handling of Silicone Resin LEDs“).
In general, sharp objects of all types should not be used, in order to prevent damage or penetration of the encapsulant, since this can lead to a degradation or damage of the component.

With the Golden DRAGON® Plus, particular care should be taken that the lens is not touched or that forces are applied to the side of the lens.

Figure 3 shows the recommended design for the pick and place tool for damage-free processing of the Golden DRAGON® Plus.
In addition, a tooling example is shown for the SIPLACE Nozzle 03064171-01 automatic placement machine. Here, the plastic cap is made from the material “Vectra“ – ESD able.

When placing the Golden DRAGON® Plus into operation, it should be assured that sufficient cooling is provided.
Depending on the given circumstances, extended operation without cooling can lead to overheating, damage or failure of the component.

Cleaning of the Golden DRAGON® Plus should only be performed with isopropyl alcohol (see also application note "Cleaning of LEDs"). Other cleansers or ultrasonic cleaning can lead to failure of the LED.

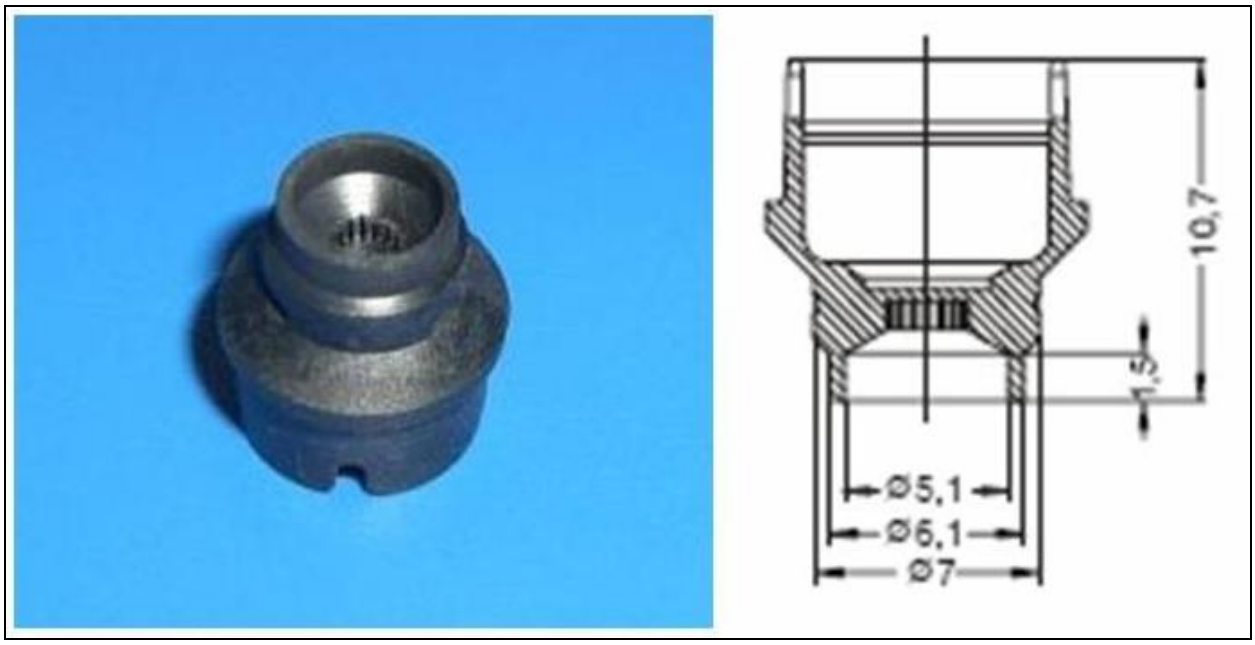


Figure 3: Recommended design of the pick & place tool for the Golden DRAGON® PLUS

Processing

The Golden DRAGON® Plus is generally supplied in tape and reel format.
Each reel only contains a single brightness group and a single wavelength or color group per color.
That is, from the brightness groups within the family, one tape contains only one of the groups.

The Golden DRAGON® Plus is generally compatible with existing industrial SMT processing methods, so that all customary populating techniques can be used for assembly.

For mounting the component, a standard reflow soldering process is recommended, in which a typical lead-free SnAgCu metal alloy solder is used.
Figure 4 shows the solder requirements and temperature curve for lead-free soldering of the Golden DRAGON® Plus.

The LED should be prepared according to JEDEC Level 4.

For optimal mounting of the Golden DRAGON® Plus to the circuit board and therefore, to guarantee the performance of the LED, it is advantageous to use the recommended solder pad in most cases.

In designing the solder pad for the DRAGON® product family, the goal was to achieve an optimal balance between good processability, the smallest possible positioning tolerance and a reliable solder connection.

In addition, however, the requirements for good thermal management should also be fulfilled.

In Figure 5, the general, optimized solder pad design is shown for the DRAGON® product family.

In order to fulfill the requirements for good thermal management with the DRAGON® LEDs, the copper surface around the integrated heatsink should be kept as large as possible. This serves to dissipate and spread the accumulated heat and is typically covered with a layer of solder resist.

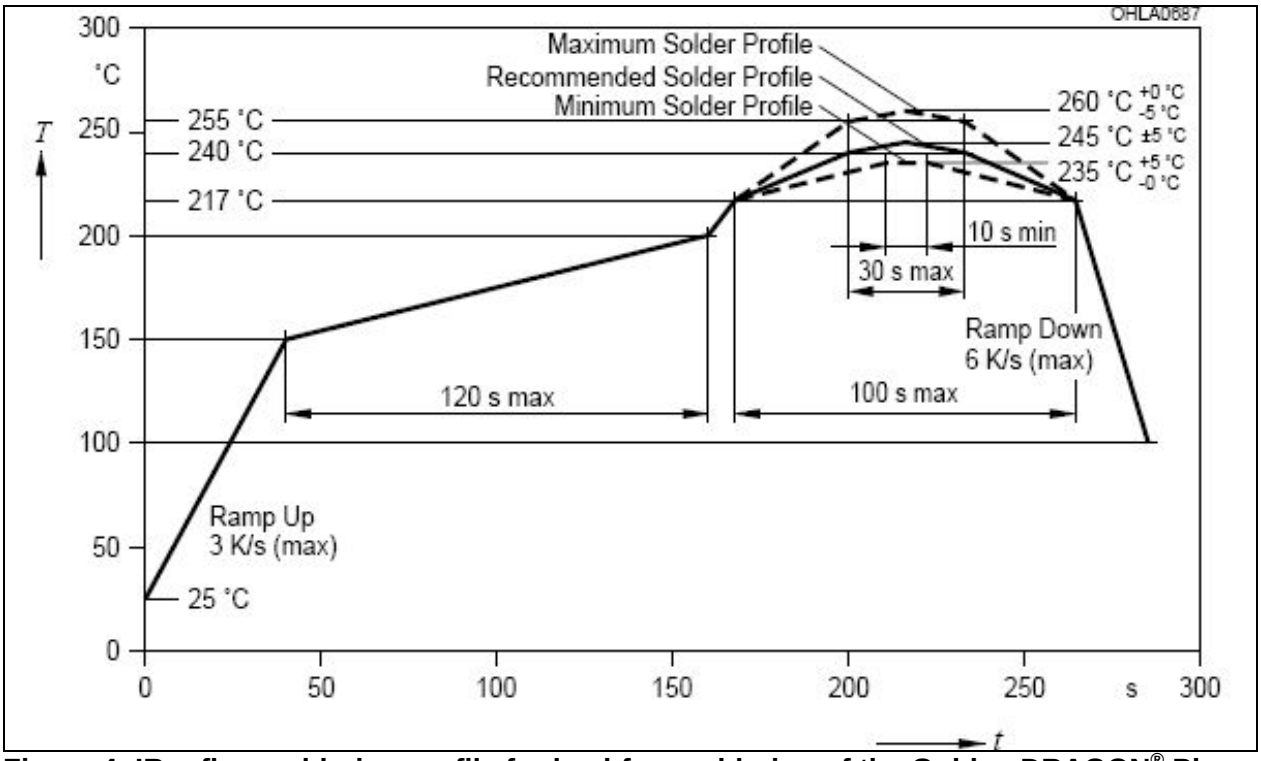


Figure 4: IR reflow soldering profile for lead-free soldering of the Golden DRAGON® Plus

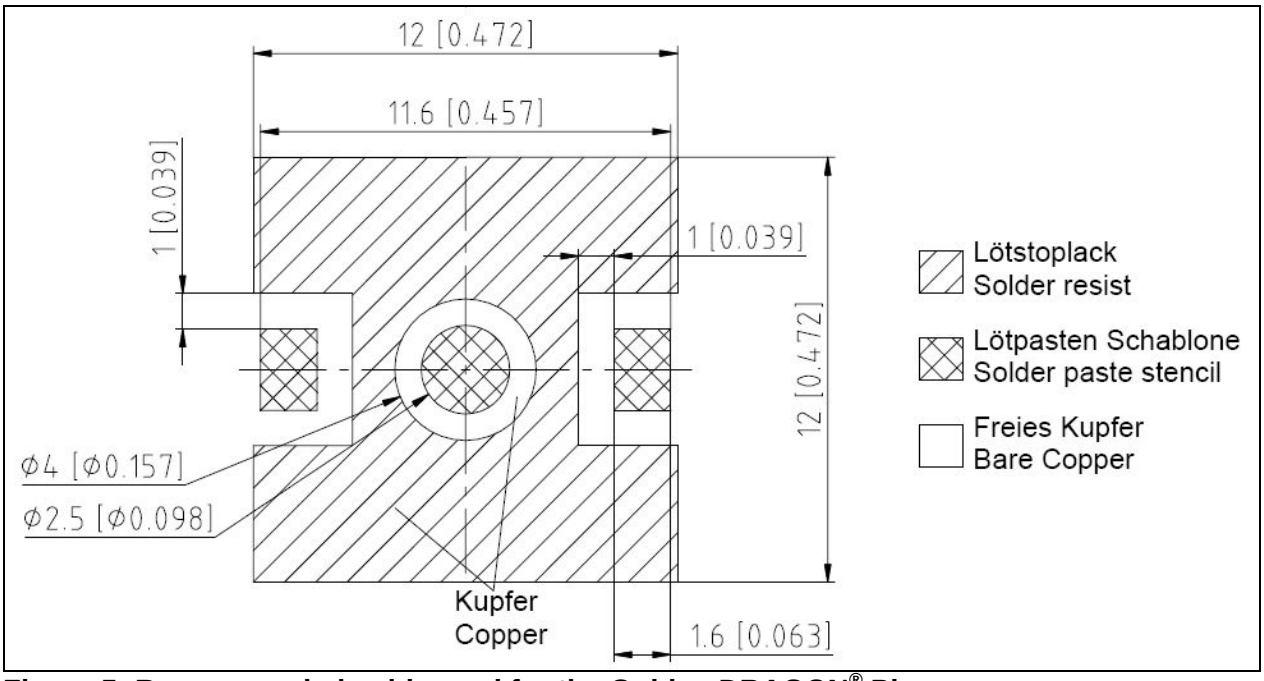


Figure 5: Recommended solder pad for the Golden DRAGON® Plus

In addition, it should be noted that the copper surface around the heatsink must be isolated from other solder pads or heatsink surfaces. The reason for this is that with the DRAGON® product family, the anode and heatsink of the housing are in electrical contact.

Since power dissipations of up to 3,8 Watts can arise for Golden DRAGON® Plus LEDs depending on the chosen operating parameters, additional heat dissipation and distribution via the circuit board is required.

The selection of appropriate materials for the circuit board is therefore of utmost importance. Materials with insufficient thermal conductivity lead to an impairment of reliability or restrict operation at optimal performance, since the heat which arises cannot be dissipated in sufficient quantities.

For this reason, insulated metal substrates (IMS-PCB) are typically used for construction of light sources with the high power LEDs of the DRAGON® product family.

These usually consist of an aluminum base plate, a thin dielectric insulator and a conducting layer of copper for the electrical connection.
Compound materials of thin, flexible circuit board material and metal substrates are also suitable, however. The combination with flexible circuit board material offers the advantage that three-dimensional designs are possible, for example.

Standard substrates such as FR4 are normally not suitable for use with high power LEDs such as the DRAGON® product family, due to their low thermal conductivity.

Tests at OSRAM Opto Semiconductors with thin FR4-material in combination with metal through contacts (thermal vias) and additional cooling (e.g. with an aluminum plate) show that this type of construction can be used (Figure 6) if a good thermal coupling of the FR4 material and the heatsink is guaranteed by means of a thermal interface material (see also application note "Thermal Management of Golden DRAGON® LED").

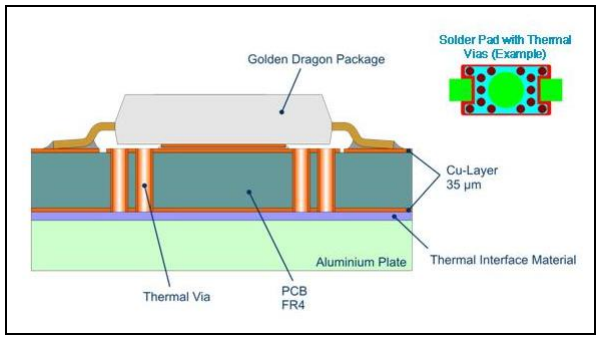


Figure 6: Conceptual layout of FR4 with thermal vias

Thermal Considerations

In order to achieve reliability and optimal performance with high-power LEDs such as the Golden DRAGON® Plus, appropriate thermal management is required.
Basically, there is a principle limitation on the maximum allowable temperature for the Golden DRAGON® Plus - the junction temperature must not exceed 125°C.

In general, the warming Golden DRAGON® Plus arises from two sources, in which one is due to an external cause (existing ambient temperature) and the other is due to internal processes (current-dependent power losses).

As a result, not all operating conditions are appropriate or permissible for a particular ambient temperature.
In the data sheets, the maximum permissible currents for DC operation and various pulse loads are given for two ambient temperatures (T_A =25°C and T_A = 85°C).

For all intermediate cases, the maximum operating conditions can be estimated by interpolation of the curves.

Influence of Junction Temperature

Basically, the maximum permissible junction temperature must not be exceeded, since

this can lead to irreversible damage and spontaneous failure of the LED.
Due to the underlying physical dependencies with the function of light emitting diodes, a change in the junction temperature T_J within the permissible temperature range has an effect on several LED parameters.
The forward voltage, luminous flux, color coordinates and lifetime of an LED are influenced by the junction temperature. Depending on the specified requirements, this can ultimately also have an effect on the application.

The amount of influence is stated or shown graphically in the Golden DRAGON® Plus data sheets; if required, current information can be obtained there.

Reliability and Lifetime

With increasing temperature, a reduction in lifetime can be observed. It should be avoided that the temperature of the circuitry or the LED is less than the ambient temperature, since this can lead to condensation, ultimately damaging the LED.

Primarily designed and developed for the use in long lifetime applications, the Golden DRAGON® Plus possesses the necessary lifetime to provide many years of service. In Table 2, the exemplary median lifetime for a medium brightness group of the Golden DRAGON® Plus is shown.

Conditions	Median Lifetime	Unit
I_F = 350mA T_J = 90°C	70.000	Operating hours
I_F = 350mA T_J = 110°C	30.000	Operating hours

Table 2: Exemplary median lifetime of the Golden DRAGON® Plus

Summary

With its optimized thermal design and improved lifetime, the Golden DRAGON® Plus LED is exceptionally well equipped and suited for use in the multifaceted area of general lighting.

Appendix

Don't forget: LED Light for you is your place to be whenever you are looking for information or worldwide partners for your LED Lighting project.

www.ledlightforyou.com

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About Osram Opto Semiconductors

Osram Opto Semiconductors GmbH, Regensburg, is a wholly owned subsidiary of Osram GmbH, one of the world's three largest lamp manufacturers, and offers its customers a range of solutions based on semiconductor technology for lighting, sensor and visualisation applications. The company operates facilities in Regensburg (Germany), San José (USA) and Penang (Malaysia). Further information is available at www.osram-os.com.