THE CUSTOMERS' PARTNER OF CHOICE

# OSRAM OPTO SEMICONDUCTORS


THERE IS LIGHT. AND THERE IS OSRAM.

OSRAM

# ONE AND ONE IS THREE.

**OSRAM**
**Opto Semiconductors**

Light Emitting Diodes (LED) only a few millimeters in size have become a serious alternative to conventional lights in many areas.

**For this reason, on 1 January 1999, Siemens Semiconductor Division and OSRAM founded a joint venture: OSRAM Opto Semiconductors GmbH & Co. OHG will develop, produce and market optical semiconductors. Headquarters of the new company is Regensburg, Germany.**

**A logical and future-oriented step with advantages for both partners:**

The worldwide lighting specialist OSRAM opens new and interesting market segments to Siemens Semiconductors. For OSRAM, the LED completes its competence in light. Now, along with lighting based on the three classic principles to generale light (“temperature radiation”, “low-pressure discharge” and “high-pressure discharge”), semiconductor light sources are part of the program.

* starting 1 April 1999
Infineon Technologies AG

# OSRAM Opto Semiconductors

SIEMENS

Infineon technologies

OSRAM

## THE ADVANTAGES ARE ALL YOURS

The greatest beneficiaries of the joint venture between Siemens Semiconductor and OSRAM are our customers:

- OSRAM Opto Semiconductors gives you access for the first time to lighting of all types – and thus to neutral, objective advice from a single source, based on what solution is truly best for your requirements.
- OSRAM Opto Semiconductors gives you the 30 years of experience and development know-how of the third-largest optical semiconductor manufacturer in the world.
- OSRAM Opto Semiconductors provides new solutions for future LED applications (e.g., fully-configured boards with LED, or ready-to-use modules as an alternative to traditional light sources), including the right electronics.

# Everything you want

**OSRAM Opto Semiconductors offers you a complete assortment:**

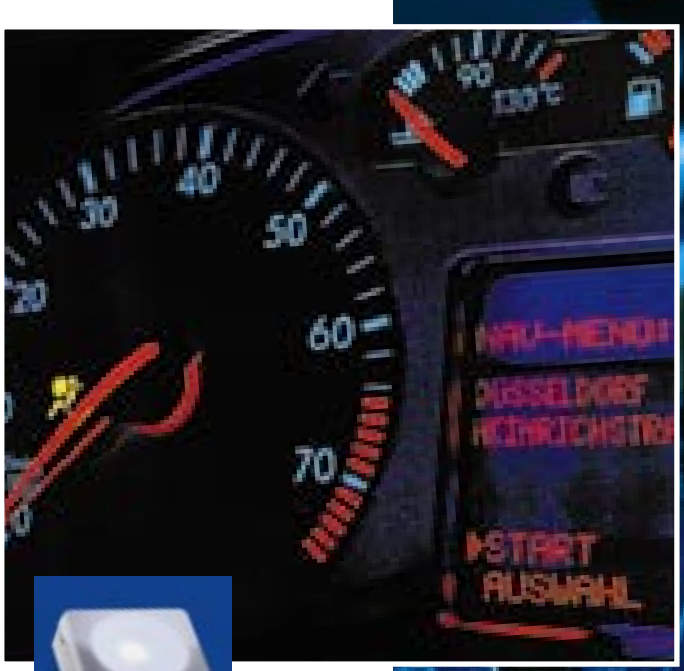
**LED:** in all colors and many different forms, radial and SMT (as well as customer-specific solutions).
Areas of use include:
- automobiles (interior and exterior lighting)
- industry
- computer peripherals
- consumer/communications (backlighting, indicators)

**Infrared:** detectors and emitters for many different applications.
Areas of use include:
- infrared remote control
- photometry
- distance measurement
- wireless communications
- sensor systems

**Displays:** intelligent and graphic displays
Areas of use include:
- large-area projections in stadiums, etc.
- telecommunications displays

**High Power Laser Diodes:**
Areas of use include:
- solid and fiber laser pumping
- measurement technology, e.g., for distance measurement and area monitoring
- direct material processing (soldering, welding, marking, engraving, hardening of surfaces, etc.)
- laser TV

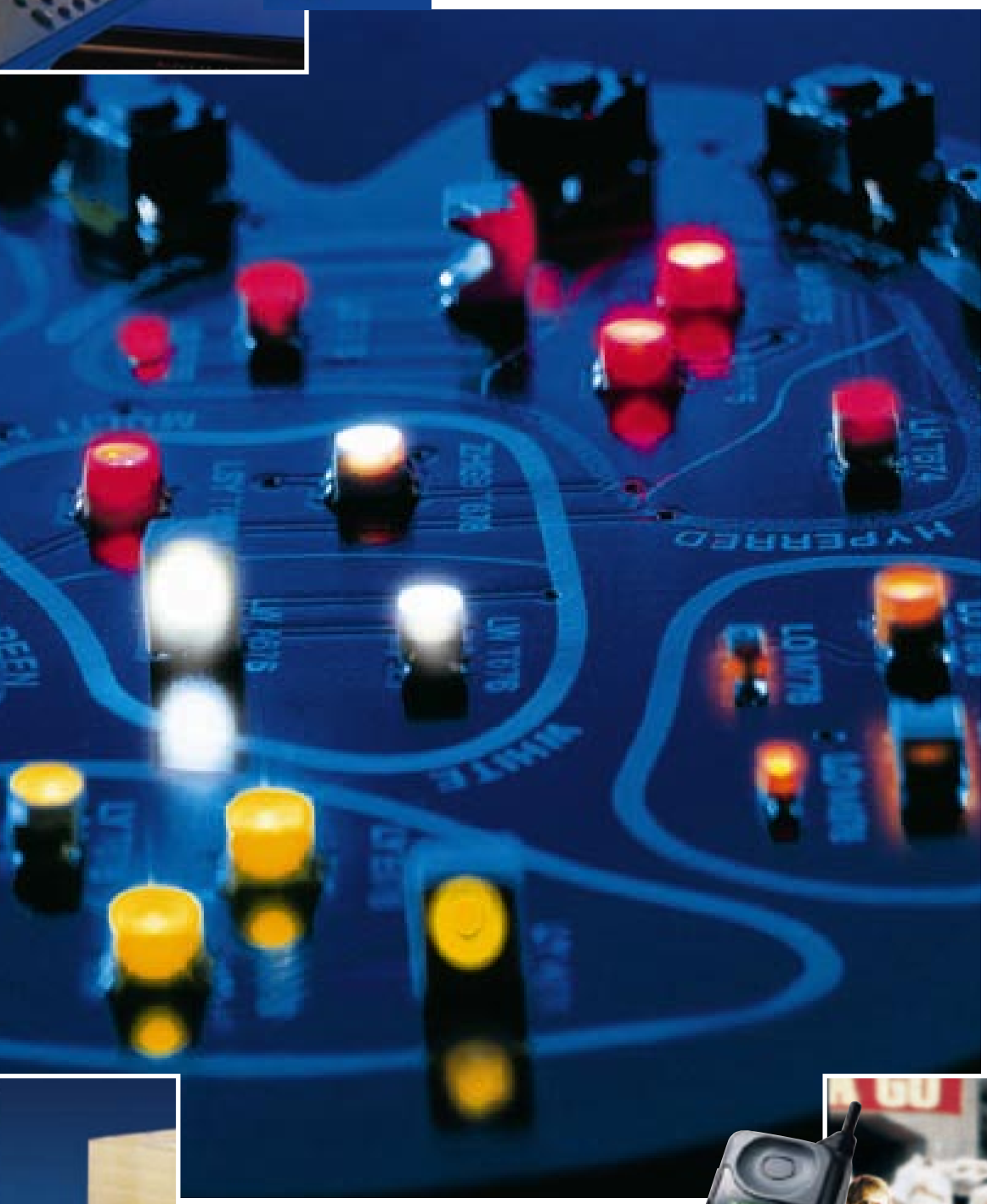
**Modules for Lighting and Signal Technology**






***Illuminating advantages***

***Modern light diodes are based on semiconductor compounds that convert power directly into light.***
***Essential advantages include:***
- ***significantly smaller size for many different design options***
- ***high shock resistance***
- ***low heat loss***
- ***stepless dimming***
- ***extremely long lifetime of 50,000 to 100,000 hours***
- ***energy savings***
- ***all colors (from 460 nm – 650 nm)***
- ***white***
- ***many different forms with different angles of radiation***
- ***power TOPLED for high brightness requirements***
- ***multi TOPLED for producing all colors from the three basic colors of red, green and blue***



## The whole world of LED

Almost every advantage of the LED is already on display in automotive engineering: sturdiness and long lifetime, high efficiency and short response time in brake lights. The small installation depth and low heat generation allow design freedom and space-saving embodiments. Thanks to the long useful life and low power dissipation, direct integration into plastic molded parts is possible.

Furthermore, white light diodes permit physiologically advantageous and spatially-distributed interior lighting for nighttime driving. Other current applications include signal systems (traffic lights, railroad signals) as well as displays and directional signs.

Light diodes, as a single light source, offer the option of implementing display systems suitable for daylight use. In Japan, large-scale displays with up to 3 million light diodes per display are already used in advertising and sports stadiums.

**Modern LED can already replace conventional lighting in many applications, and their development is ongoing.**

# A GLIMPSE INTO THE FUTURE

Today, LED already offer a substantially better energy balance than traditional incandescent bulbs. In the future, our sought-after increase in efficiency to 30 percent will save energy compared with conventional bulbs even more.

OSRAM Opto Semiconductors encompasses completely new areas of use for light diodes – from general lighting to traffic control technology to street lighting. The LED also opens new creative design options for light designers with colored and white lights.


***Area of use:***
***Automotive lighting:***
***LED used as rear light and as 3rd brake light – even today automobile lighting is inconceivable without the LED.***

***Area of use:***
***Public lighting:***
***LED are sturdy and long-lived – ideal for high-maintenance outdoor applications such as, in this case, traffic control systems.***

*Area of use:*
*General lighting:*
*In the future, LED could be used for lighting design, e.g., "starry heavens."*

## General information and security technology

Colored LED display boards suitable for daylight applications will increasingly be used to present information in public facilities, railroad stations, airports, local transportation systems and the like as well as for general announcements, short films, advertisements, etc.

Other areas of use include traffic signals and traffic control systems for roads and parking areas where current lighting based on semiconductor systems have fixed configurations.

Systems based on LED pixels are significantly more flexible and simpler to implement, since almost any desired symbol can be depicted with intelligent circuitry. These systems also offer higher reliability and can exercise great optical appeal, e.g., through color changes.

White LED are ideal for use in indoor safety warnings or emergency exit signs. For example, directional arrows, staircases and steps can be visibly marked in the event of power failure. Such displays are easy to implement independently of the power network or with solar power. LED are also suitable for outdoor use: road signs and house numbers with network-independent lighting provide easier nighttime orientation.

## Innovative lighting

OSRAM Opto Semiconductors develops light modules based on LED that achieve approximately the efficiency of current energy-saving lights. These modules can be used wherever temperature or space limitations prevent the use of conventional means of illumination.

Thanks to their small size, light diodes are also highly suitable for strong backlighting of flat liquid crystal displays.

## Sensor systems

There are many new applications in the field of infrared technology, e.g., presence detectors, seat occupancy sensors, distance sensors and sensors for a wide variety of x-ray analysis procedures.

*Area of use:*
*Display lighting:*
*Thanks to their high efficiency and minimal power consumption, LED are ideal for lighting large-area display boards.*

*Area of use:*
*Public lighting systems:*
*LED are ideal as a source of light for traffic lights and other road signs.*



*Area of use:*
*General lighting:*
*As in this example, LED can be used for emergency lighting and illuminated signs.*

# Partnership practiced successfully: the white LED

Siemens Semiconductor and OSRAM have worked together intensively and successfully even before their current joint venture. Demonstrative proof of this fruitful partnership is the white LED. The underlying technology is called “luminescence conversion.”

### White LED light through luminescence conversion

Previously, the only way to produce white LED light was by the additive color mixing of the three basic colors using so-called MULTILED, i.e., three semiconductor chips (red, green and blue LED) had to be combined.

Today we can produce white LED light with only a single chip. In luminescence conversion, only a blue LED is used, whose light stimulates a luminescent substance that emits yellow light. In interaction, the system produces the color white.

This light is generated on the basis of a principle similar to that used in luminescent substance lighting. Depending on the composition of the luminescent substance, various white tones can be realized.

In developing this chip, the core competencies of Siemens and OSRAM complemented each other in ideal fashion.

- Siemens Semiconductor brought its fundamental know-how in chip development and manufacture as well as packaging, while
- OSRAM contributed its decades of experience in working with illumination.

In the future, the synthesis of these complementary core competencies in semiconductor technology and lighting engineering will lead to new product solutions and even faster technological progress in the field of LED.

*Fig. 1: Yellow luminescent substance*

*Fig. 2: Blue LED*

## THE WHITE LED:

Essential for its creation:

- a semiconductor chip that emits blue light (Figure 2)
- forms and transparent sealing compounds that protect the chip during further processing (Figure 3)
- converter material that changes blue-wavelength light into yellow light (Figure 1).

The two colors mix so as to appear white to the observer.

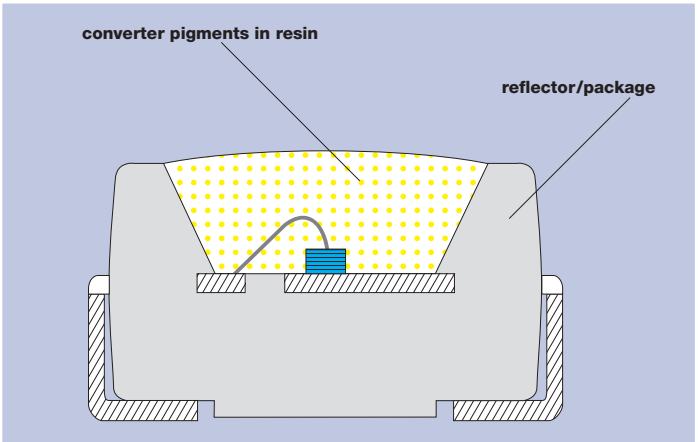



*Fig. 3: Functional principle of white LED*

# What you can depend on

**Constant improvement in our processes and continuous quality monitoring of our fully-automated production lines in Germany, Malaysia and northern China guarantee a future-oriented alignment of products.**

## Highest quality

QS 9000 forms the basis of the quality system of OSRAM Opto Semiconductors. This system covers all our commercial processes, and all Opto Semiconductor units are internationally qualified in accordance with EN/CEEC 100114, ISO 9001, ISO 9002 and QS 9000/VDAG. Ongoing self-assessments and audits ensure quality on the international level, and the overall quality assurance effort is integrated into a Total Quality Management System in keeping with the EFQM model. The highest goal is not to simply fulfill customer expectations, but to exceed them. Together with its customers, suppliers and employees, OSRAM Opto Semiconductors sets the standards needed to ensure quality and reliability.

Under the guidelines of the zero-defect program, any product failures that occur at OSRAM Opto Semiconductors are analyzed and measures are introduced to prevent their recurrence. As a result, an output product quality of < 1 dpm was achieved in 1998 for Mini TOPLED and TOPLED, while the rate for all products in the OS spectrum was < 6 dpm. In the year 2000 the value should be < 3 dpm.

***Epitaxial and chip processes, such as the metal coating of semiconductors shown here, require special sterile areas. Development and manufacturing are carried out in Regensburg.***

***The photo-lithographic processes for producing structures on semiconductor chips are carried out in special yellow rooms.***

***Computer-assisted inspection of microstructures on semiconductor chips. Trained personnel monitor the process.***

*Modern SMD housings tested millions of times are produced in a variety of forms on our assembly lines in Malaysia. All processes are mechanized and linked. These highly modern production lines are a prerequisite for ensuring optimal quality level.*

*MOVPE technology as the key to superbright LED. The successful application of MOVPE technology allows coatings on the magnitude of only a few nanometers to be produced.*

*Successful process improvement is ensured by extensive long-term testing. The illustration shows a stress frame that monitors the useful life of the chips in a wide variety of operating conditions (e.g., power and temperature). Information on the useful life of the chips is derived from this procedure.*

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