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Processing of LEDs — Information on the multi-chip ceramic OSLON Submount CL LEDs

Application Note

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Abstract

This application note provides basic information on the handling and processing of the multi-chip ceramic OSLON Submount CL from OSRAM Opto Semiconductors.

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Table of contents

A. OSLON Submount CL 2
B. Precautions & storage 3
C. Manual handling 4
D. Cleaning 4
E. Pick & place nozzle design 5
F. Press area and force 5
G. Device references for placement 6
H. Gluing process 7
I. Bonding process / bond interface 8
J. Thermal measurement point 8
K. Summary 9

A. OSLON Submount CL

Designed as a compact light source in multi-chip on board technology, the OSLON Submount CL LEDs are certified according to IEC 60810 and USCAR-33.

The LEDs consist of a ceramic-based substrate, which has an electrically isolated bottom side and two contact blocks on the top side for the electrical contact. Depending on the version of the high-flux LED, several semiconductor chips are mounted in series and separately covered with a converter platelet. The chips and their gold (Au) wire bonds are molded with a white silicone. The bottom side of the ceramic substrate features an Au finish and is designed for an adhesive process (gluing) with a proper heat conductance towards the heat sink. Further specific components of the LED are the two top contact blocks, which are aluminum-plated (Al) and designed for aluminum wire or aluminum ribbon bonding. Both contact blocks are also embedded with white silicone.

As is common practice, the processing of the LED such as gluing and bonding lies under the direct responsibility of the customer and has to be developed and qualified by the customer. Detailed information concerning the quality of the surface, as well as acceptance and non-acceptance conditions are described and shown in the failure catalog of the LED.

As with all LEDs from OSRAM Opto Semiconductors, the LED also fulfills the applicable RoHS guidelines (EU + China) and contains no lead or other defined hazardous substances.

B. Precautions & storage

The LED is equipped with an ESD protection diode, connected to the LED string in parallel, which provides an ESD resistance of up to 8 kV according to ANSI/ESDA/JEDEC JS-001 (HBM, Class 3B).

Nevertheless, please be aware of ESD safety while handling LEDs. As a matter of principle, the common ESD safety precautions must be observed during the handling, assembly and production of electronic devices (LEDs).

Figure 1: Package outline of the 2-chip version of the OSLON Submount CL

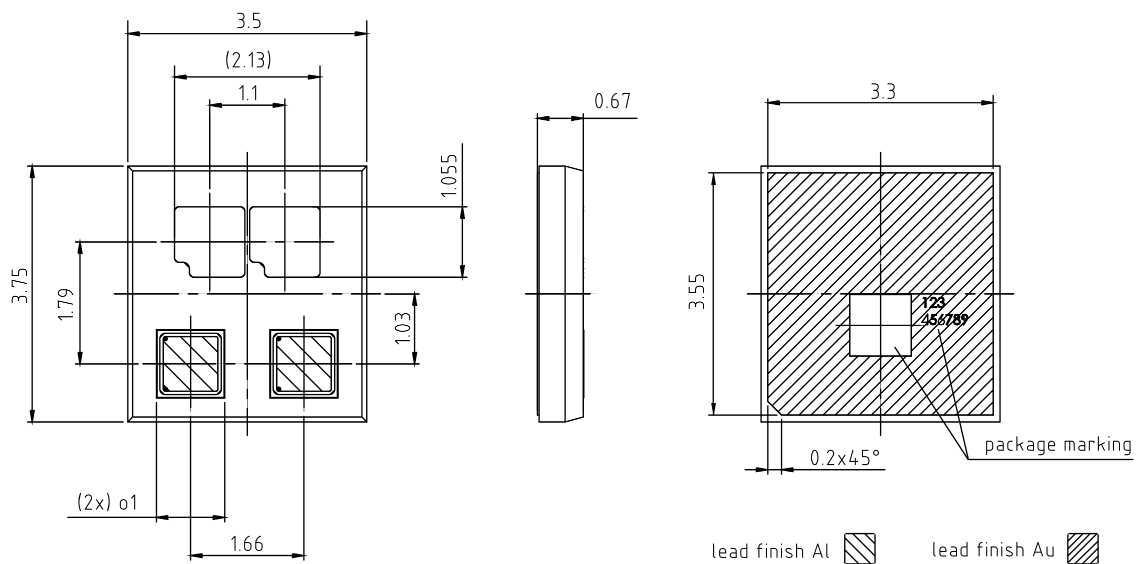
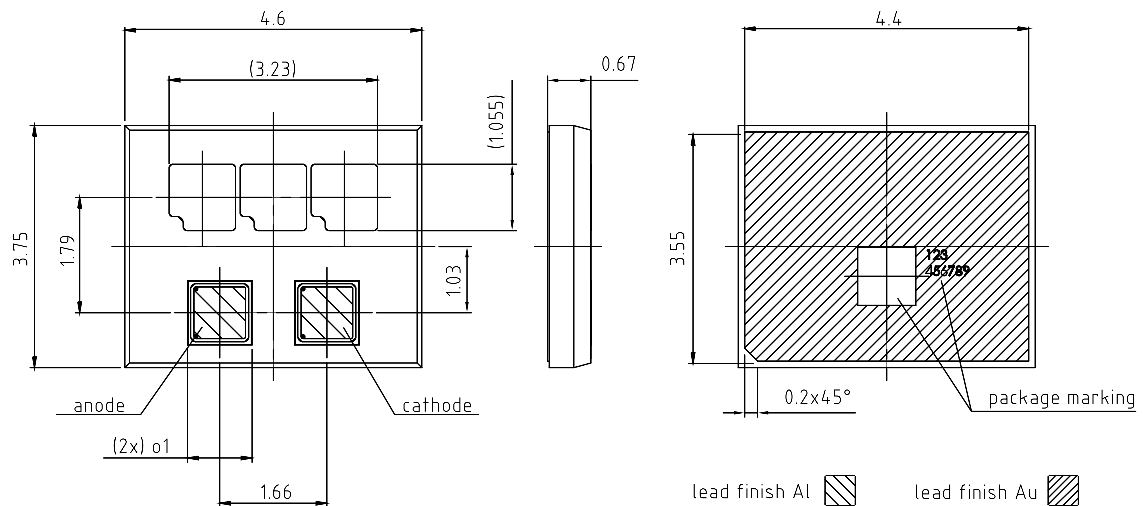


Figure 2: Package outline of the 3-chip version of the OSLON Submount CL



The LEDs are packaged in tape and on reel. For storage and dispatch, the reels are packed in vacuum-sealed dry bags together with desiccants.

It is generally recommended to leave the reels in their packaging until used and to store components during processing in ambient conditions of ≤ 10 % RH. Drying cabinets with dry nitrogen (N_2) or dry air are suitable for this type of storage.

As the LEDs are not reflow solderable, the declaration of a moisture sensitive level (MSL) does not apply. However, the requirement of usage after opening the dry pack package advises processing within 24 h (comparable to MSL 5a) to avoid contamination or deterioration of the surfaces. In this context please be aware that the different metalizations of the LED are sensitive towards humidity, salt fog and acid materials. The influence of these materials can damage the surfaces in such a way that the gluing and bonding process is adversely affected or in the worst case is no longer possible. To prevent any damage over their lifetime OSRAM Opto Semiconductors recommends to cover the bonded wire or ribbon with an appropriate glob top material.

C. Manual handling

Following general guidelines for the handling of LEDs, additional care should be taken to minimize mechanical stress on the silicone encapsulation. In general, all types of sharp objects (e.g. forceps, fingernails, etc.) should be avoided to prevent damage to the encapsulation or wire bonds, which could lead to the spontaneous failure of the LED.

For manual assembly and placement — in the production of prototypes, for example — the diligent use of tweezers is recommended. Thereby the LED must be picked and handled only at the ceramic substrate (see Figure 3). Be sure to follow ESD safety precautions.

Figure 3: Manual Handling of the OSLON Submount CL

D. Cleaning

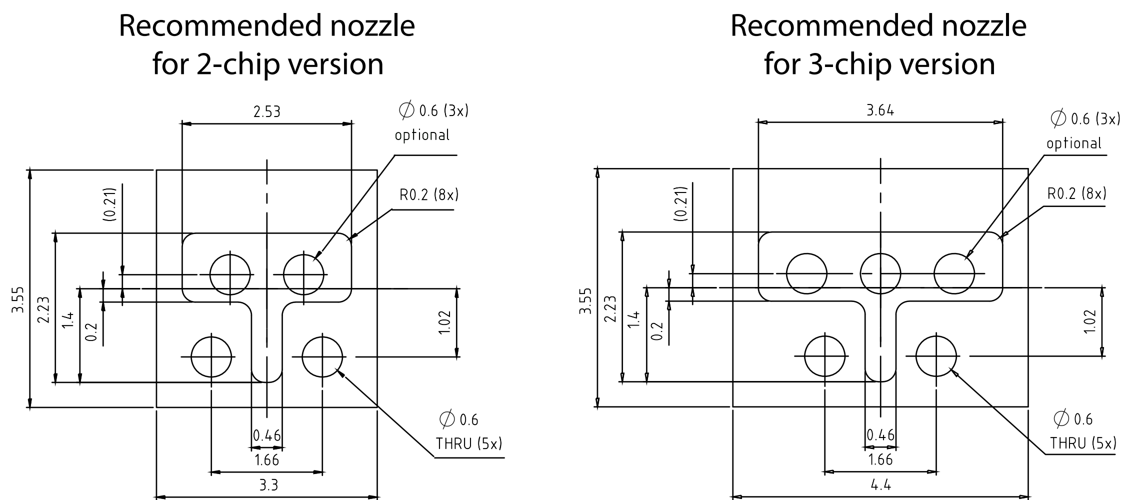
From today's perspective any direct mechanical or chemical cleaning of the LED should be avoided. Isopropyl alcohol (IPA) can be used if cleaning is mandatory. Other substances or especially ultrasonic cleaning are generally not recommended. For dusty LEDs, a simple cleaning process using purified compressed air (e.g. central supply or spray can) is recommended.

In any case, all materials and methods should be tested beforehand, particularly as to whether or not damage is associated with the component.

E. Pick & place nozzle design

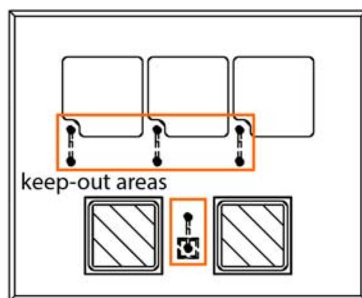
If the processing of the LEDs is performed by means of automated placement machines, care should be taken to use an appropriate pick and place tool and to ensure that the process parameters conform with the package characteristics. Figure 4 shows the recommended design of the placement tool for the damage-free processing of each version of the LED.

Figure 4: Example of a customized pick and place tool



The material of the nozzle should be non-metal e.g. Vespel (plastics) to avoid scratches on the bond pad and the ceramic converter platelets. The pick-up tool may only touch the contact block surfaces. Furthermore, the cavity of the pick-up tool must be centered over the conversion layers. The keep-out areas for the nozzle, which should prevent the risk of wire bond pre-damage, are shown in Figure 5.

Figure 5: Keep-out areas for designing a customer specific nozzle



F. Press area and force

The fixation of the submount to the heatsink is done by gluing. Precaution must be taken not to pre-damage the surface or scratch it. Using the appropriate

nozzle, there is a maximum allowable force applicable on the LED during the gluing process. During this process the maximum allowable force applicable through an elastic nozzle is 800 g for a maximum time of 2 s. The area to apply the force is limited to the contact pads.

G. Device references for placement

For a precise centering of the OSLON Submount CL, OSRAM Opto Semiconductors recommends that you use the optical center point of the device as a reference point. The optical center point is the geometric balance point of the rectangle completely enclosing the light emitting area of the chip (see Figure 6, left-hand side) and can be determined by an appropriate camera and software equipment (Figure 6, right-hand side).

The optical center point of the device can be determined directly if the tool used is capable of recognizing the contrast between the converter layer and the surrounding surface precisely and can also be adjusted to the geometry of the chip (excluding the notch). In this case, it is recommended that the center point of the left-hand side converter layer (from the top) is used as the reference point. For the dimensions of the OSLON Submount CL please refer to Figure 7. If the camera settings allow for different lighting, the best results might be obtained using blue illumination.

If the system cannot precisely distinguish between chip and notch or substrate, it is recommended to use the center point of the left bond pad as a reference point (Figure 7). However, in this case make sure that you take the additional tolerance into account, arising from the distance between the bond pad center and the optical center.

Figure 6: Schematic sketch and camera picture of the optical center point

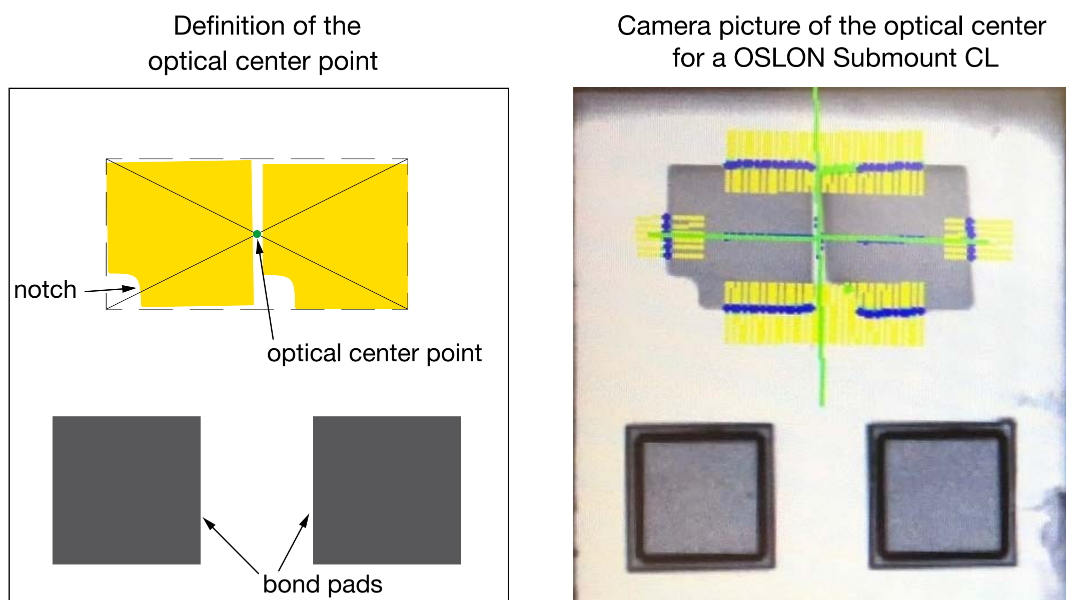
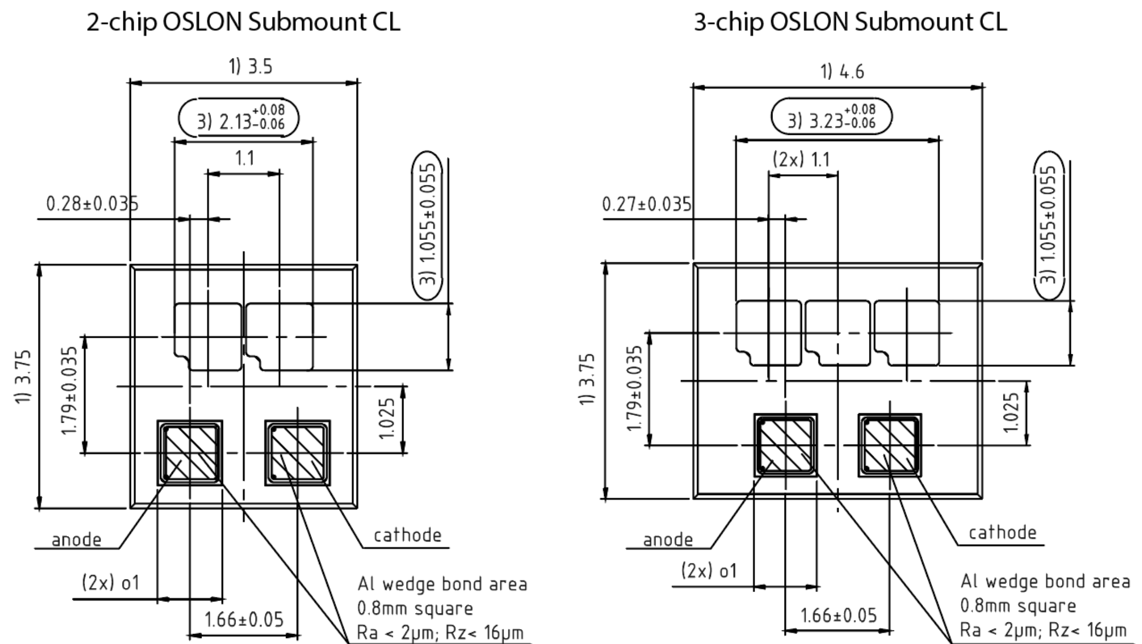


Figure 7: Reference points of the OSLON Submount CL (smallest tolerance chain)



H. Gluing process

The OSLON Submount CL is designed for mounting on any kind of proper heat sink by a gluing process.

For that the LEDs are qualified for the following maximum parameters:

- Resistance to thermal glue curing 210 °C
- Time exposure 45 minutes
- Allowable curing cycles 3

Any exceeding of these maximum values has to be clarified with and accepted by OSRAM Opto Semiconductors.

The bottom side of the LED substrate offers a metalization with an Au finish which has no electrical contact to the top.

Special attention should be paid to the selection of an appropriate adhesive, also especially with regard to its thermal properties. Adhesives with insufficient thermal conductivity or improper processing may lead to the deterioration of reliability or restrict operation at optimal performance, since in this case the heat generated during operation of the LED cannot be dissipated in sufficient quantities.

Basically, there is a principle limitation on the maximum allowable temperature for the multi-chip ceramic LED — the junction temperature must not exceed 150 °C during operation.

Please be aware that any contamination of the backside must be avoided during handling.

I. Bonding process / bond interface

The contact blocks are specially designed for aluminum wire bonding or Al ribbon bonding (125 - 300 µm) and have a 5 µm thick Al-plated surface on the bond pad.

For a correct wire bond process any contamination of the pads must be avoided during the previous processing.

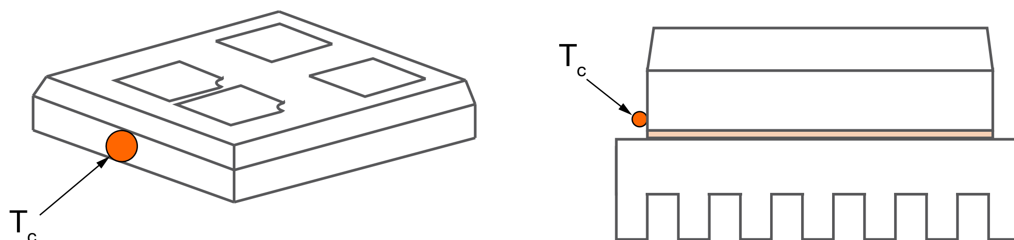
Please be aware that the contacts of the LED are not suitable for gold wire bonding.

Please also bear in mind that aluminum surfaces, such as the contact blocks and the Al bond wires, are sensitive to liquid water and chloride. For this reason they need to be protected from such materials during the mounting process and in the application.

J. Thermal measurement point

As previously described, the OSLON Submount is not soldered when implemented in an application, due to its special product design. Because of this, no solder point is available. Instead, T_{case} (T_c) is introduced. For measuring T_c the thermocouple can be placed directly onto the ceramic at the side of the device where the chips are located (see Figure 8).

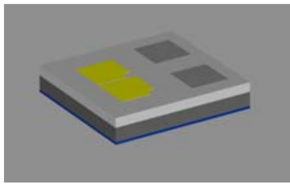
Figure 8: Ideal mounting position of a thermocouple for the OSRAM OSLON Submount CL



The thermal simulation (Figure 9) with a P_{Heat} of 4.3 W shows that the temperature detected at the recommended measuring point on the surface is 54.2 °C. It almost matches the board temperature T_c which is simulated at 53.4 °C. Therefore, it can be used for the calculation of the junction temperature.

Figure 9: Thermal simulation of the board temperature for the OSRAM OSLON Submount CL

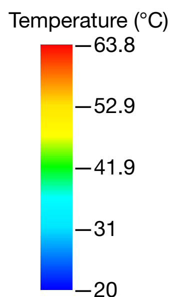
Simulation model:

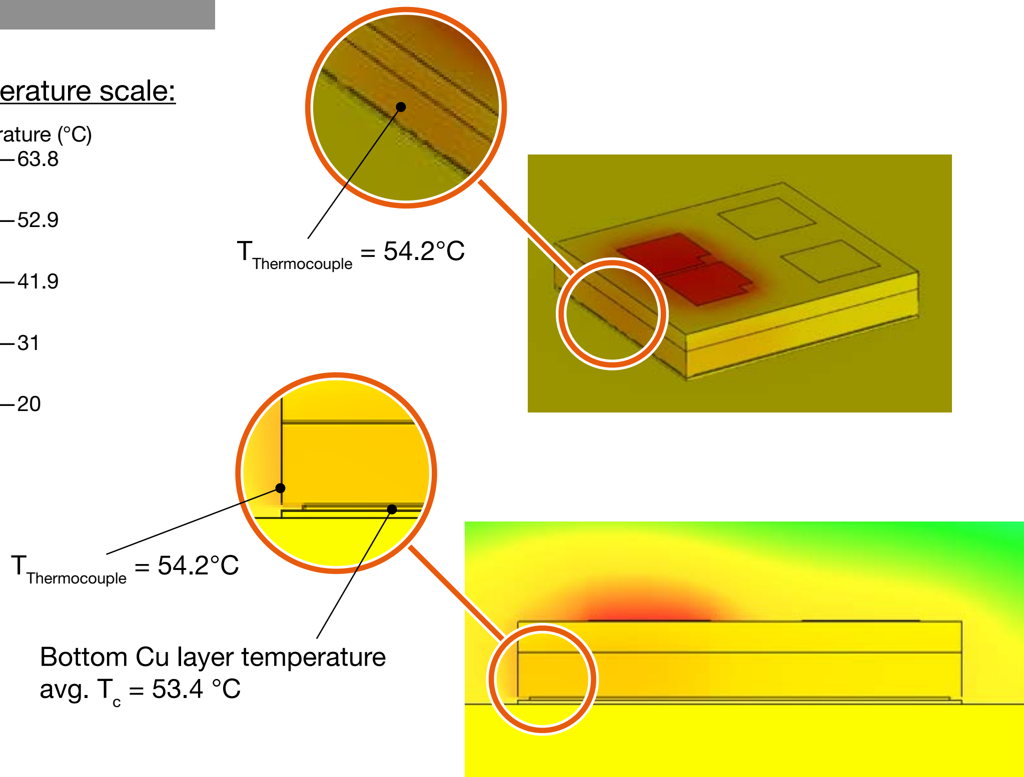


Boundary conditions:

- P_{Heat} = 4.3 W (I_F = 1 A; typ. V_F = 6.3 V; η = 34%)
- Ambient temperature T_{amb} = 20 °C
- Still air
- Conjugate heat transfer

Temperature scale:





K. Summary

Generally supplied in tape and on reel, the OSLON Submount CL is compatible with existing industrial SMT processing methods — excluding reflow soldering — so that standard assembly techniques can be used.

Despite the classification as a Class 3 (HBM) ESD-sensitive device, handling and processing of the LED must conform with ESD.

It should also be borne in mind that the LED is not suitable for any direct mechanical or chemical cleaning.

As is common practice the processing of the LED such as gluing and bonding lies under the direct responsibility of the customer and has to be developed and qualified by the customer.

With regards to the aluminum used for the surface plating and wire bonds please bear in mind that Al is sensitive to liquid water and chloride and needs protection, especially within applications.

OSRAM Opto Semiconductors supports its customers in finding the best solution for a specific application during their development and design process.

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

ABOUT OSRAM OPTO SEMICONDUCTORS

OSRAM, Munich, Germany is one of the two leading light manufacturers in the world. Its subsidiary, OSRAM Opto Semiconductors GmbH in Regensburg (Germany), offers its customers solutions based on semiconductor technology for lighting, sensor and visualization applications. OSRAM Opto Semiconductors has production sites in Regensburg (Germany), Penang (Malaysia) and Wuxi (China). Its headquarters for North America is in Sunnyvale (USA), and for Asia in Hong Kong. OSRAM Opto Semiconductors also has sales offices throughout the world. For more information go to www.osram-os.com.

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