The multi-chip ceramic OSLON® Submount CL and PL LEDs

Application Note

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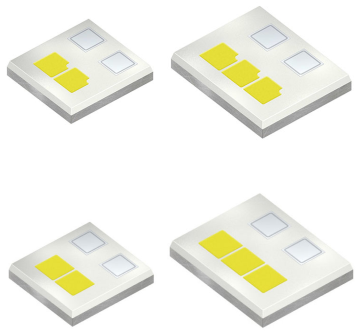
The multi-chip ceramic OSLON® Submount CL and PL LEDs

Application Note No. AN033

Valid for:
KW C2L5L1.TE / KW C3L5L1.TE
KW C2L5L2.TK / KW C3L5L2.TK
KW2 C2LNL3.TK / KW3 C3LNL3.TK
KW2 C2LPL3.TK / KW3 C3LPL3.TK

Abstract

This application note provides recommendations for proper handling and processing of the multi-chip ceramic OSLON® Submount CL and PL. Please read carefully and follow the instructions in order to avoid damages to the LED and secure long lifetime under application conditions.



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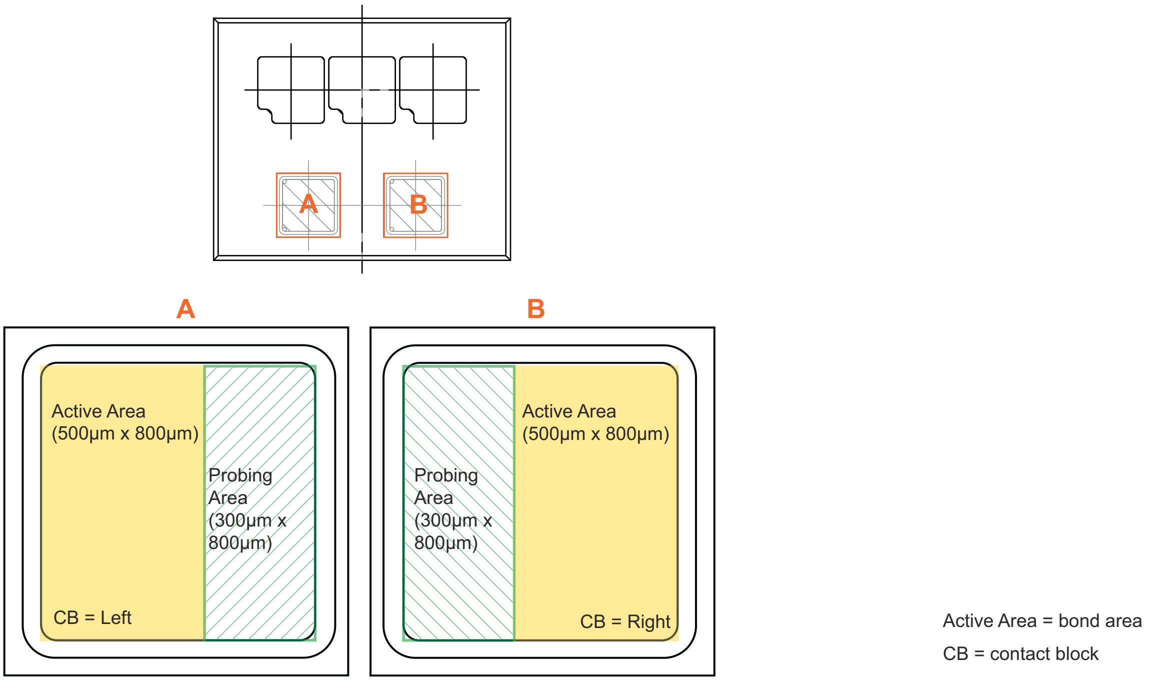
1 General information

Designed as a compact light source in multi-chip on board technology, the OSLON® Submount CL and PL LEDs are certified according to IEC 60810 and USCAR-33. The devices are designed for glue connection and ribbon bonding, but not for any soldering method.

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.

The two top contact blocks (anode and cathode) are aluminum-plated (Al) and designed for aluminum wire or aluminum ribbon bonding by the customer. These contact blocks have a dedicated probing area of 300 µm x 800 µm as shown in Figure 1. Both contact blocks are also surrounded by white silicone.

Figure 1: Dedicated probing area



The component height of the OSLON® Submount PL version is higher than the OSLON® Submount CL version (for details please refer to the data sheet, examples for the 2-chip versions are shown in Figure 2-5).

Figure 2: Package outline of the 2-chip version of the OSLON® Submount CL (KW C2L5L1.TE)

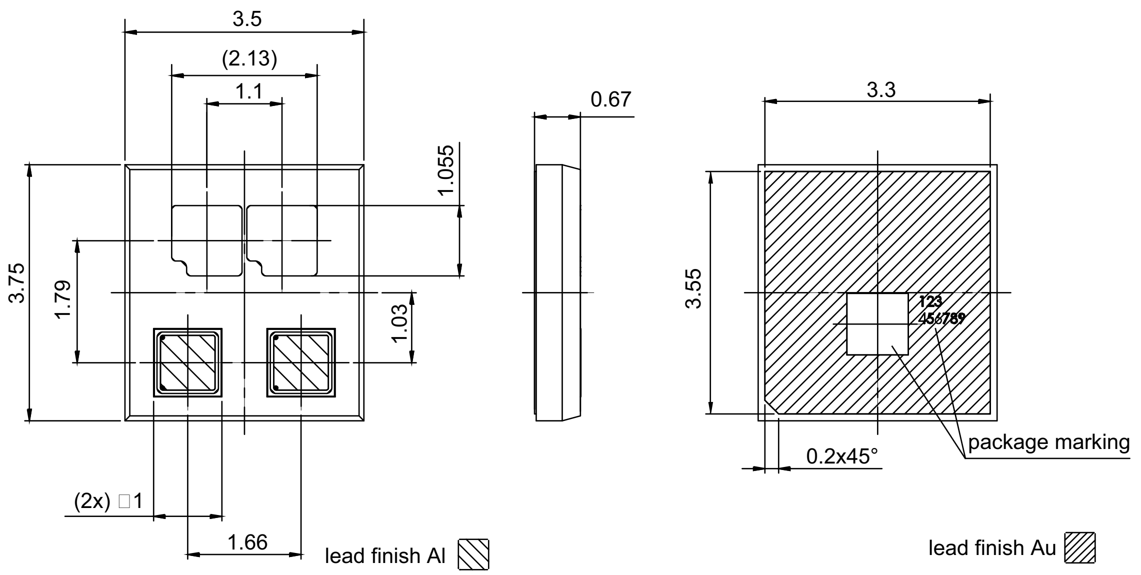


Figure 3: Package outline of the 2-chip version of the OSLON® Submount PL (KW C2L5L2.TK)

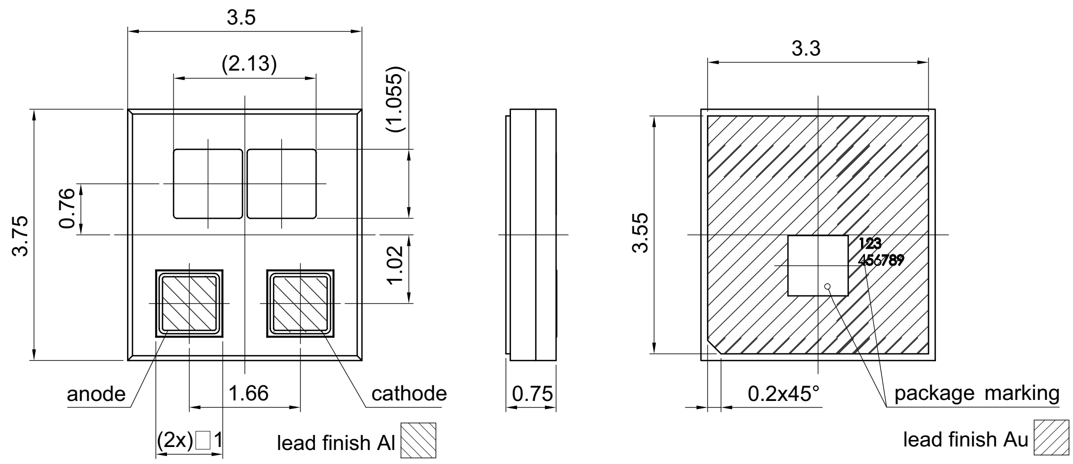


Figure 4: Package outline of the 2-chip version of the OSLON® Submount PL (KW2 C2LNL3.TK)

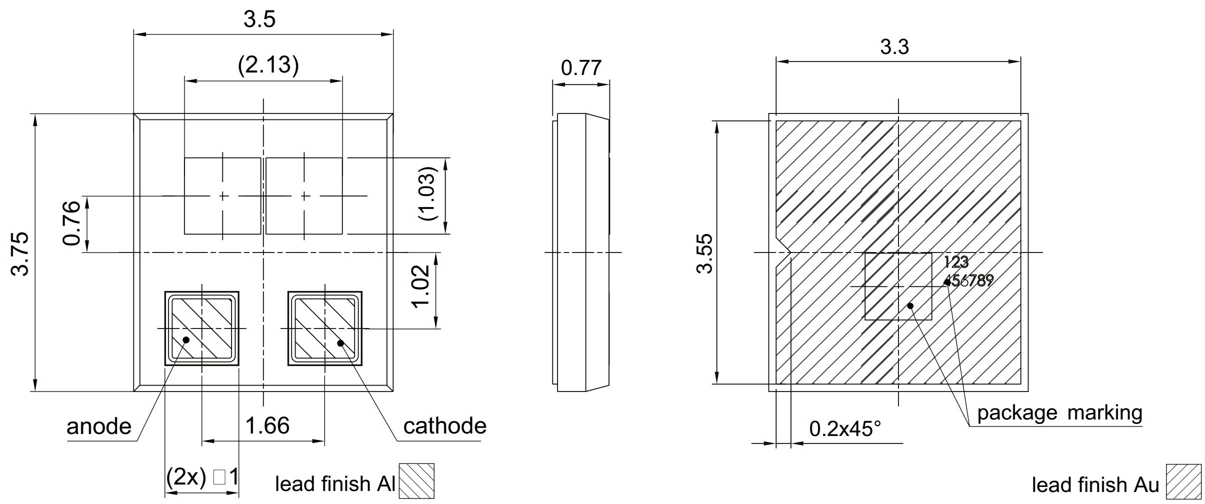
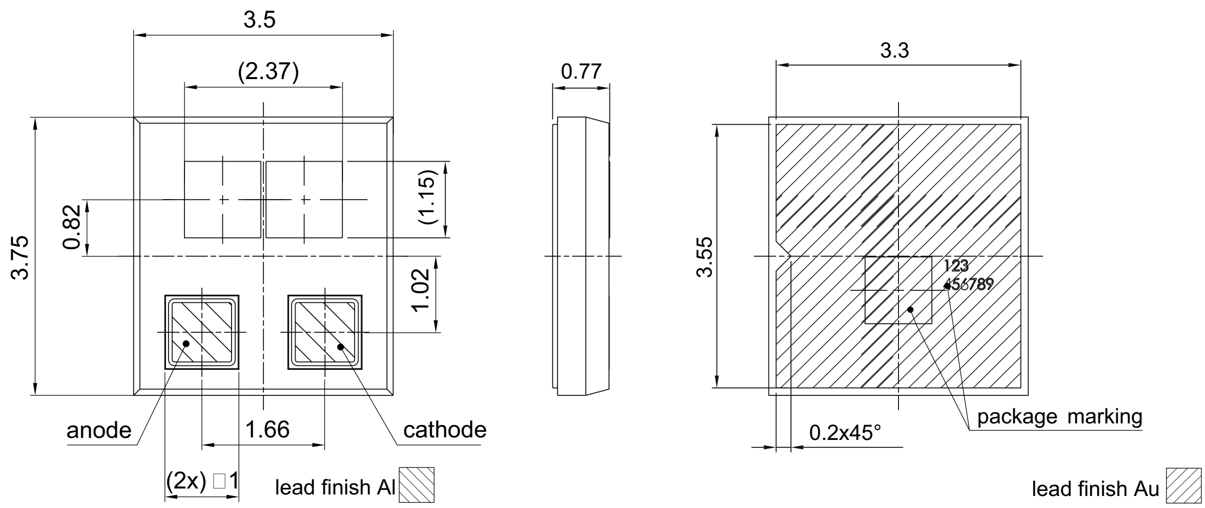


Figure 5: Package outline of the 2-chip version of the OSLON® Submount PL (KW2 C2LPL3.TK)



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 ams-OSRAM, the LED also fulfills the applicable RoHS guidelines (EU + China) and contains no lead or other defined hazardous substances.

1.1 Mechanical and optical design resources

For detailed information on the mechanical dimensions please refer to the drawings available in the data sheet. To obtain CAD data and optical rayfile, please visit the "Optical Simulation / Ray Files + Package CAD Data" webpage on ams-OSRAM AG website.

For more information on importing rayfiles and ray-measurement files, please refer to the application note "Importing rayfiles and ray-measurement files of LEDs".

1.2 Corrosion robustness

LEDs are categorized in several corrosion robustness classes, depending on material properties. Each robustness class reflects different test conditions.

The LEDs fulfill the requirements of corrosion robustness class 3A. For further information on how to prevent failures caused by corrosive materials and corrosion robustness classes, see the "Preventing LED failures caused by corrosive materials" application note.

2 Handling recommendations

LEDs are exposed to various mechanical stresses during processing and in application. However, each mechanical stress has direct effects on the functionality and lifetime of the LED. Excessive stress may lead to a LED failure. Whether defects occur or how robust an LED is in regard to certain stresses is productspecific. For detailed information please refer to the application note "Fundamentals of LED handling".

The use of any kind of sharp objects should generally be avoided, since this can damage the component. The LED light emitting area should generally not be touched or punctured as this can damage the component.

2.1 ESD stability

As an additional ESD protection is included the LED provides ESD stability of up to 8 kV. It is assigned to the "Class 3B HBM" category in accordance with ANSI / ESDA / JEDEC JS-001. With this class the LED can be considered as uncritical for processing and assembly by state of the art SMT equipment aligned with ESD precautions. To achieve higher ESD protection on the system level, additional ESD protection must be applied.

Nevertheless, please be aware of ESD safety while handling LEDs. As a matter of principle, common ESD safety precautions must be observed during the handling, assembly and production of electronic devices (LEDs). For further information on ESD protection please refer to the application note "ESD protection while handling LEDs".

2.2 Cleaning

Any direct mechanical or chemical cleaning of the LED should be avoided. Isopropyl alcohol (IPA) can be used if cleaning is mandatory. Other substances, and especially ultrasonic cleaning, are generally not recommended.

For dusty LEDs, simple cleaning by means of purified compressed air (e.g. central supply or spray can) is recommended. In order to ensure that the compressed air does not contain any oil residues, the use of a spray can is recommended. A maximum pressure of 4 bar at a distance of 20 cm to the component should be observed.

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

2.3 Precautions and storage

For storage and dispatch, the reels or trays are packed in vacuum-sealed dry bags together with desiccants. It is generally recommended to leave reels in their original packaging until they are assembled, and to store components under ambient conditions of ≤ 10 % RH during processing. Drying cabinets with dry nitrogen (N_2) or dry air are suitable for this type of storage. The LED complies with moisture-sensitive Level 2 (MSL 2) according to JEDEC J-STD- 020E.

LEDs are generally supplied in tape with a dry pack and should stay factory-sealed when stored. This package should only be opened immediately before mounting and processing, after which the remaining LEDs should be repacked according to the moisture level in the datasheet (see JEDEC J-STD-033 - Moisture Sensitivity Levels). For further information on dry pack please refer to the application note "Fundamentals of LED handling", especially if long-term storage is desired.

A suitable storage system should be implemented in order to ensure that assembled LED boards are not stacked on top of each other (Figure 6). To avoid the risk of damage to the assembled LEDs, make sure that they are not exposed to compression forces of any kind. Furthermore, the LED of the assemblies must also not be touched directly. Generally, all LED assemblies should return to room temperature after soldering, before subsequent handling, or next process step.

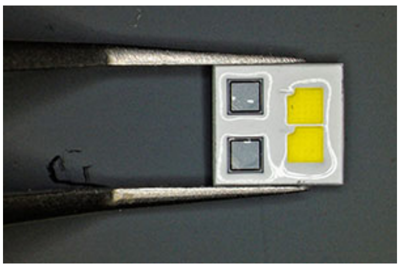
Figure 6: Correct storage

2.4 Manual handling

When handling LEDs, the general guidelines must be observed. Mechanical stresses (e.g. shear forces) should be excluded or reduces as far as possible (see also application note "Fundamentals of LED handling"). In general, all types of sharp objects (e.g. forceps, fingernails, etc.) should be avoided in order to prevent stress to or penetration of the encapsulation, as this can lead to impairment of the component.

Automated placement of the LEDs is strongly recommended. Even if manual handling and mounting is possible, it should be avoided. Special care must be taken if manual handling is necessary. 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 7). The LED must not be lifted from the top, because this may cause damages to the surface. In addition, it is recommended to hold the LED package by using tweezers and applying the force equally to the entire LED package. Be sure to follow ESD safety precautions.

Figure 7: Manual Handling of the OSLON® Submount

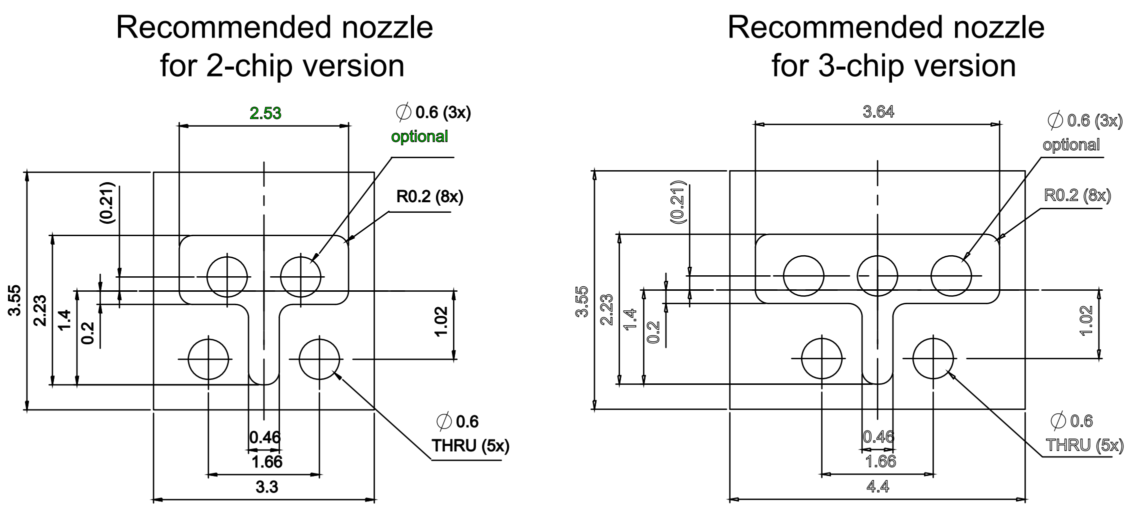


3 Processing

3.1 Pick and place nozzle design

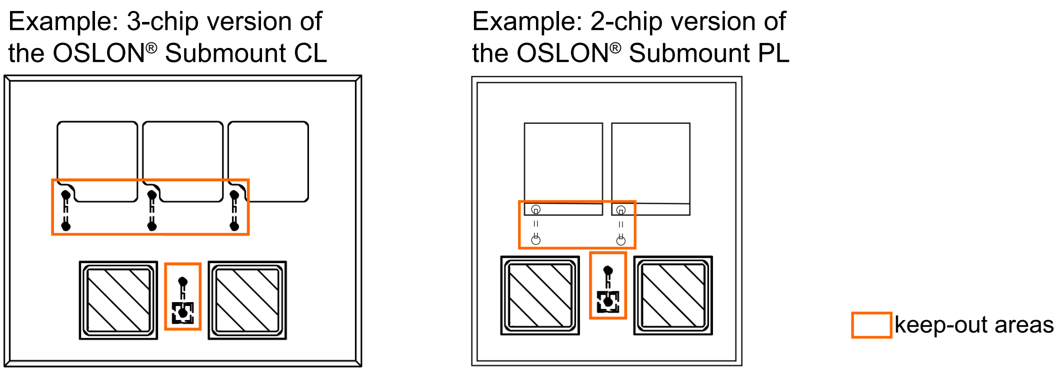
If the processing of the LEDs is performed by means of automated placement machines, care should be taken to use an appropriate pick and place tool and to ensure that the process parameters conform with the package characteristics. Figure 8 shows the recommended design of the placement tool for the damage-free processing of each version of the LED.

Figure 8: 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 9.

Figure 9: Keep-out areas for designing a customer specific nozzle



3.2 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.

3.3 Device references for placement

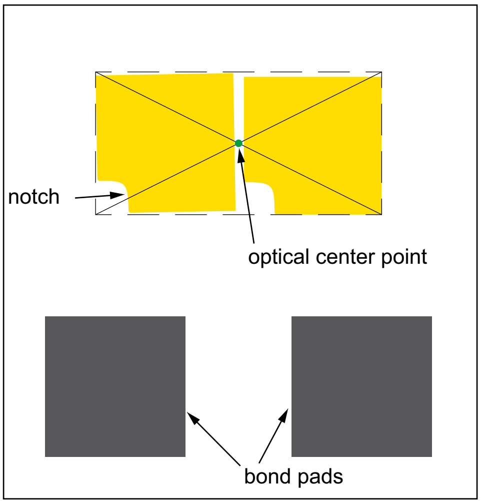
For a precise centering of the OSLON® Submount CL and PL, ams-OSRAM recommends to use the optical center point of the device as a reference point. The optical center point is the geometric balance point of the rectangle completely enclosing the light emitting area of the chip (see Figure 10, left-hand side) and can be determined by an appropriate camera and software equipment (Figure 10, 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 and PL please refer to datasheet. If the camera settings allow for different lighting, the best results might be obtained using blue illumination.

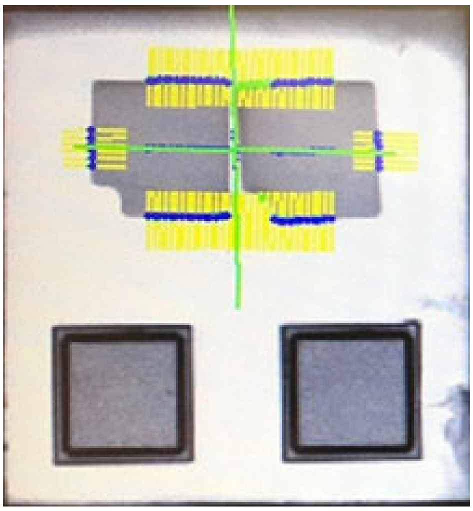
If the system cannot precisely distinguish between chip and notch or substrate, it is recommended to use the center point of the left bond pad as a reference point. In this case, however, the additional tolerance resulting from the distance between the center of the adhesive pad and the optical center must be taken into account.

Figure 10: Schematic sketch and camera picture of the optical center point

Definition of the optical center point



Camera picture of the optical center for a OSLON® Submount CL



The graphic shows the OSLON® Submount CL variant, but is identical for the OSLON® Submount PL variant, except that no notch is visible for the PL variant.

3.4 Gluing process

The OSLON® Submount CL and PL 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

If these maximum values are exceeded, this must be clarified with and accepted by ams-OSRAM.

The bottom side of the LED substrate offers a metallization 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.

3.5 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.

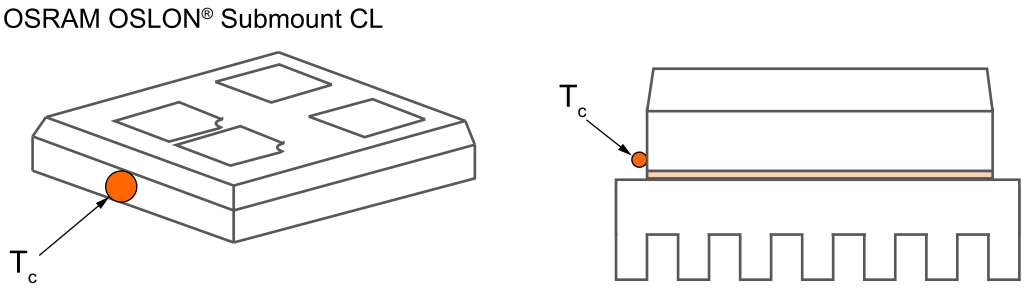
Please also bear in mind that aluminum surfaces, such as the contact blocks and the Al bond wires, are sensitive to liquid water and chloride. For this reason they need to be protected from such materials during the mounting process and in the application.

4 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.

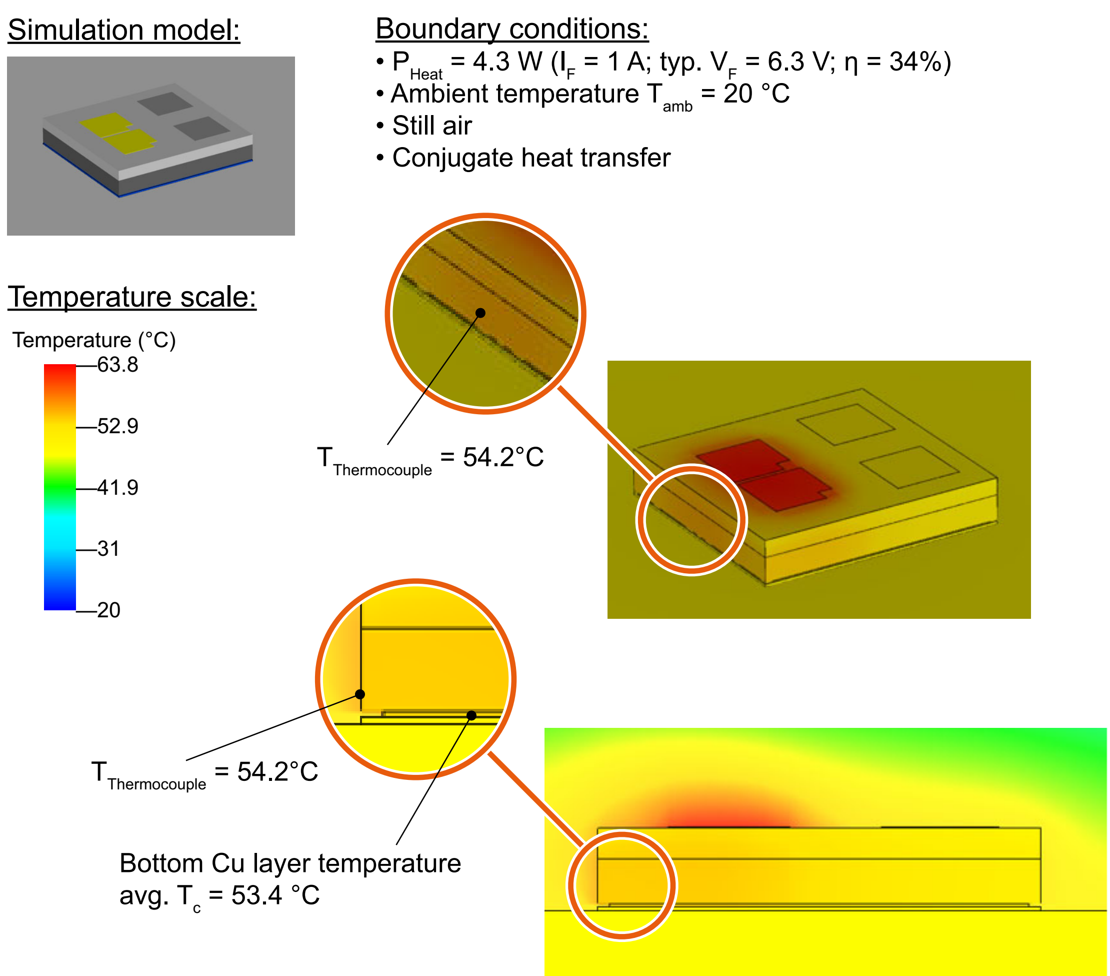
Instead, T_{case} (T_c) is introduced. For measuring Tc the thermocouple can be placed directly onto the ceramic at the side of the device where the chips are located. Figure 11 shows OSLON® Submount CL as an example, but also applies to the OSLON® Submount PL version.

Figure 11: Ideal mounting position of a thermocouple for the OSLON® Submount CL



The thermal simulation (Figure 12) 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 12: Thermal simulation of the board temperature for the OSRAM OSLON® Submount KW C2L5L2.TK



5 Summary

Generally supplied in tape and on reel, the OSLON® Submount 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 considered 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.

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

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The ams OSRAM Group (SIX: AMS) is a global leader in optical solutions. By adding intelligence to light and passion to innovation, we enrich people’s lives. This is what we mean by Sensing is Life. With over 110 years of combined history, our core is defined by imagination, deep engineering expertise and the ability to provide global industrial capacity in sensor and light technologies. Our around 24,000 employees worldwide focus on innovation across sensing, illumination and visualization to make journeys safer, medical diagnosis more accurate and daily moments in communication a richer experience. Headquartered in Premstaetten/Graz (Austria) with a co-headquarters in Munich (Germany), the group achieved over EUR 5 billion revenues in 2021. Find out more about us on https://ams-osram.com

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