OSLON® Compact — Details on handling and processing

Application Note

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OSLON® Compact — Details on handling and processing

Application Note No. AN030

Valid for:
OSLON® Compact CM / CL / PL
OLSON® Boost HM

Abstract

Light sources from a compact package with small footprint, constant color location and good thermal stability - for different automotive application areas - that is what this product family offers. This application note provides an overview of the products with information on special design features. It describes how to handle and process the individual LEDs for a good application implementation.

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1 Design of the OSLON® Compact

The OSLON® Compact is especially developed for use as small size high-flux light source with operating currents between 50 mA and 1.5 A constant current depending on the respective device and with focus on slim designs in automotive applications. The LED design consists of a ceramic substrate based on AIN (Aluminum nitrite) on which a highly efficient semiconductor chip is mounted and electrically connected. In addition, the LED features an ESD protection diode, which provides ESD stability of up to 8 kV according to ANSI/ESDA/JEDEC JS-001 - HBM, Class 3B. The rest of the small size package consists of a white embedding material. The electrical contacts are located underneath the ceramic substrate. Table 1-5 gives an overview on the various LEDs

As with all LEDs from ams-OSRAM AG, the OSLON® Compact also fulfills the current RoHS guidelines (European Union & China).

Table 1: Product overview CM

Product		Characteristics
LUW CEUN.CE		Package size: 1.6 mm x 1.2 mm 2 Pad design I_{max} = 700 mA

Table 2: Product overview CL

Product		Characteristics
LCY CEUP.CE		Package size: 1.9 mm x 1.5 mm 2 Pad design I_{max} = 1500 mA
LUW CEUP.HD		Package size: 1.9 mm x 1.5 mm 2 Pad design I_{max} = 1500 mA

Table 3: Product overview PL

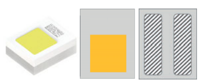
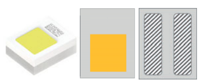
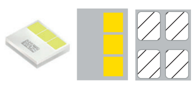
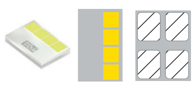
Product		Characteristics
KW CELNM2.TK		Package size: 1.9 mm x 1.5 mm 3 Pad design I_{max} = 1500 mA
KW CELNM3.TK		Package size: 1.9 mm x 1.5 mm 3 Pad design I_{max} = 1500 mA
KW CWLNM3.TK		Package size: 1.9 mm x 1.5 mm 2 Pad design Chip size: 1030 µm I_{max} = 1500 mA
KW CWLPM3.TK		Package size: 1.9 mm x 1.5 mm 2 Pad design Chip size: 1150 µm I_{max} = 1500 mA
KW2 CFLNM2.TK		Package size: 2.5 mm x 3.1 mm 4 Pad design I_{max} = 1500 mA
KW3 CGLNM2.TK		Package size: 3.6 mm x 3.1 mm 4 Pad design I_{max} = 1500 mA
KW4 CHLNM2.TK		Package size: 4.7 mm x 3.1 mm 4 Pad design I_{max} = 1500 mA

Table 3: Product overview PL

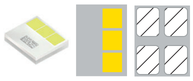
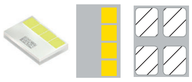
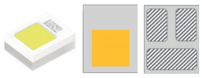
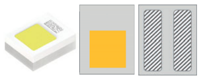
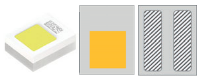
Product		Characteristics
KW2 CFLNM3.TK		Package size: 2.5 mm x 3.1 mm 4 Pad design I_{max} = 1500 mA
KW3 CGLNM3.TK		Package size: 3.6 mm x 3.1 mm 4 Pad design I_{max} = 1500 mA
KW4 CHLNM3.TK		Package size: 4.7 mm x 3.1 mm 4 Pad design I_{max} = 1500 mA
KY CELNM2.FY		Package size: 1.9 mm x 1.5 mm 3 Pad design I_{max} = 1500 mA
KW CELNM3.T1		Package size: 1.9 mm x 1.5 mm 3 Pad design I_{max} = 1500 mA
KW CWLNM3.T1		Package size: 1.9 mm x 1.5 mm 2 Pad design Chip size: 1030 µm I_{max} = 1500 mA
KW CWLPM3.T1		Package size: 1.9 mm x 1.5 mm 2 Pad design Chip size: 1150 µm I_{max} = 1500 mA

Table 4: Product overview PM

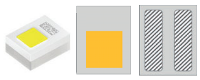
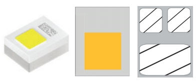
Product		Characteristics
KW CVLMM2.TK		Package size: 1.6 mm x 1.2 mm 2 Pad design I_{max} = 1000 mA
KW CDLMM2.TK		Package size: 1.6 mm x 1.2 mm 3 Pad design I_{max} = 1000 mA

Table 5: Product overview Boost HM

Product		Characteristics
KW CELMM1.TG		Package size: 1.9 mm x 1.5 mm 3 Pad design I_{max} = 1650 mA
KW CELMM2.TK		Package size: 1.9 mm x 1.5 mm 3 Pad design I_{max} = 1300 mA

1.1 OSLON® Compact CM / CL

The OSLON® Compact CM (LUW CEUN) has the smallest package, with dimensions of 1.2 mm x 1.6 mm and provides an operating range of 50 mA to 700 mA. In contrast, the OSLON® Compact CL (Lx CEUP) has a package size of 1.5 mm x 1.9 mm. The OSLON® Compact CM / CL LEDs have a chip with bond notch and are available in white and converted yellow.Figure 1 shows an example of the design on the OSLON® Compact.

Figure 2 shows the solder pad design. It is a 2 pad design with anode and cathode.

Figure 1: Design of the OSLON® Compact CM / CL

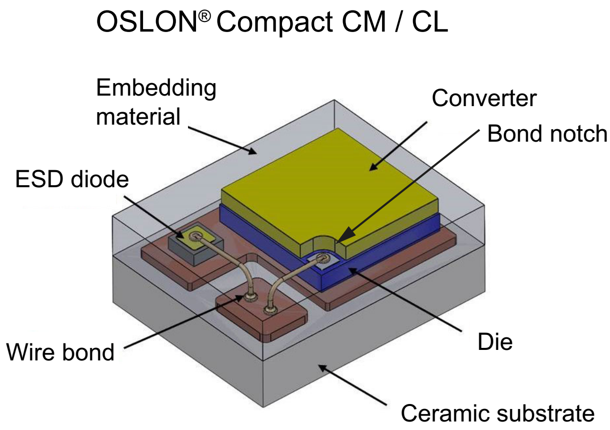
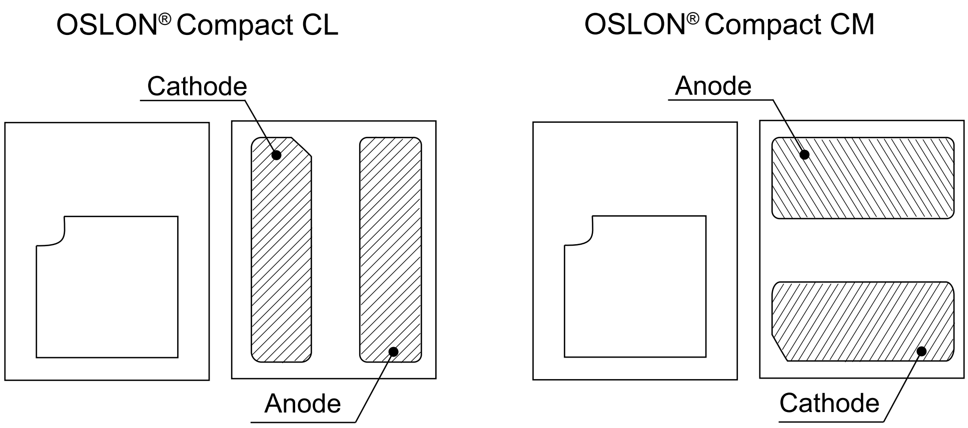


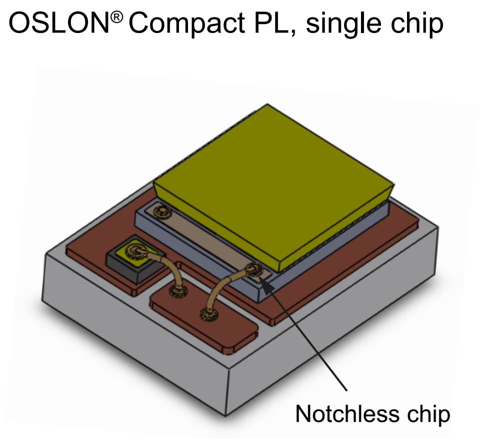
Figure 2: Solder pad design of the OSLON® Compact LEDs CL/ CM



1.2 OSLON® Compact PL

The OSLON® Compact PL series offers various LED designs, with package sizes ranging from 1.5 mm x 1.9 mm (1-chip LED) to 4.7 mm x 3.1 mm (4-chip LED). This LEDs use a notchless chip, which is illustrated as an example in Figure 3 for the single chip version.

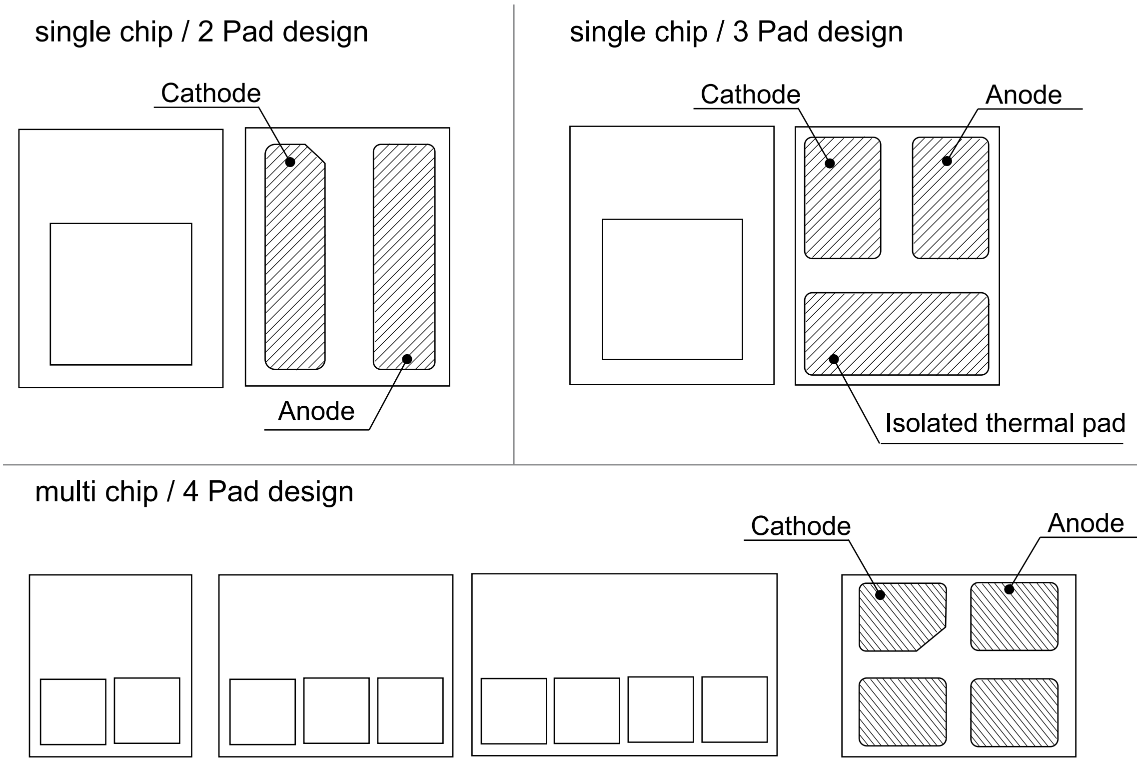
Figure 3: Design of the OSLON® Compact PL



All products are ceramic based LEDs. 1-chip LEDs are available in 2-pad designs (offering improved solderjoint reliability) or in a 3-pad design (offering improved thermal management due to the isolated thermal pad). All other 2-chip to 4-chip LEDs have a 4 pad design and then offer good soldering performance with the component geometry. The chip size varies for some models.

In total these selection results in maximum variety and the appropriate LED for the respective application can be selected. Figure 4 shows the 2 pad, 3 pad and 4 pad footprint designs of the OSLON® Compact family.

Figure 4: Solder pad design of the OSLON® Compact PL



1.3 OSLON® Compact PM

The OSLON® Compact PM provides high luminance in combination with high flux performance. The smallest possible distance between light emitting surface and optical system allows high resolution for ADB (Advanced Driving Beam). With the flexible portfolio of a 2 and 3 pad version it can be adapted to different application requirements.

1.4 OSLON® Boost HM

The OSLON® Boost HM is an high electrical power LED with a specially designed package. It is larger and with a chip size of ½ mm² it is possible to achieve a higher luminous flux and a large luminance from a small emission area. With these LEDs, slim headlamp designs and small lens components are possible. They provide a reliable and efficient thermal management of the headlamp system.

2 Handling

When handling LEDs, the general guidelines must be observed. Mechanical stresses (e.g. shear forces) on the elastic silicone encapsulation should be excluded or reduces as far as possible. In general, all types of sharp objects (e.g. forceps, fingernails, etc.) must 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 use of so-called vacuum tweezers is recommended (Figure 5). The mechanical stress on the LED will be minimized by the use of a suitable soft rubber suction tip.

Figure 5: Examples of vacuum styluses

If there is no alternative to the exceptional use of a tweezers, the LED must be picked and handled only at the ceramic substrate (Figure 6).

Figure 6: Handling of the OSLON® Compact

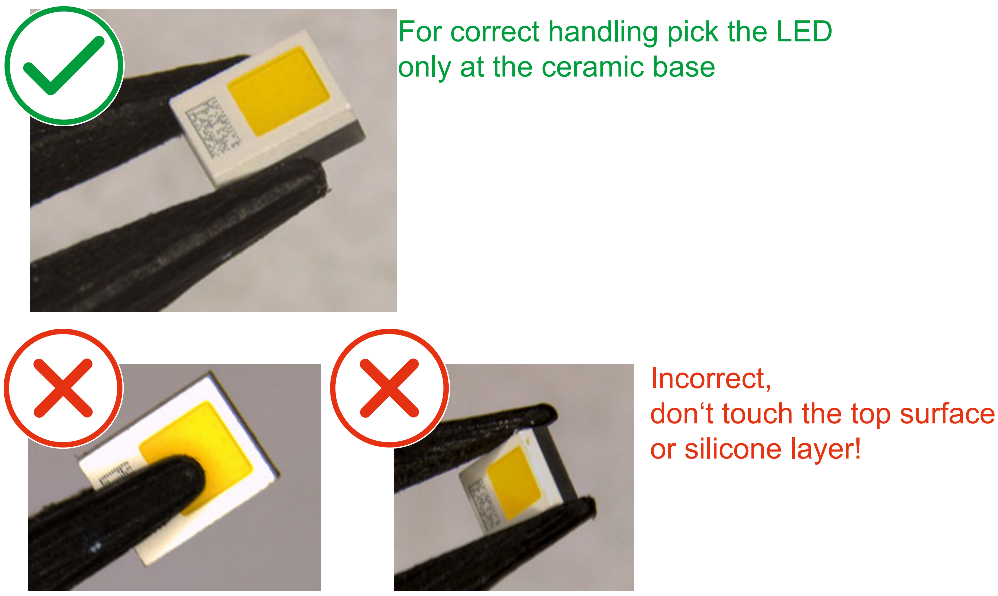
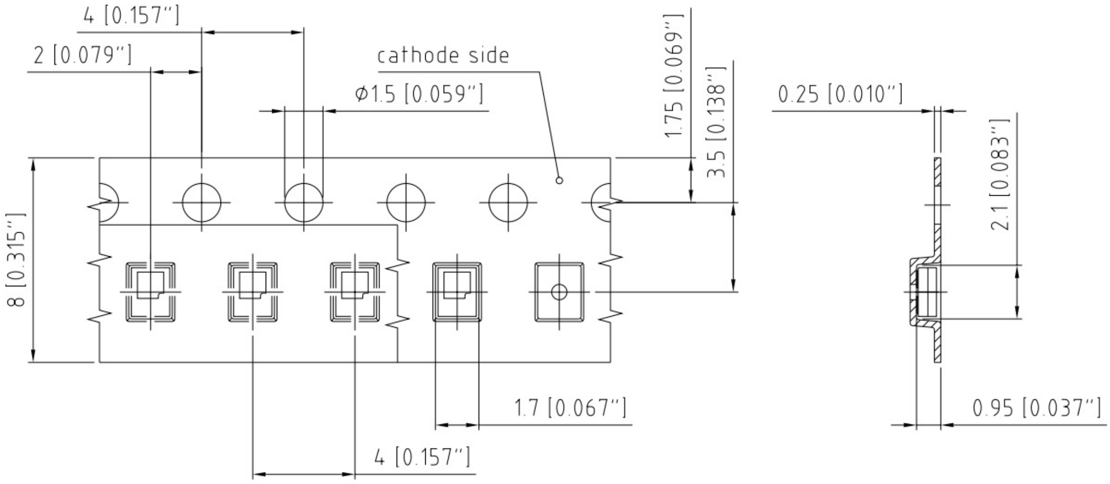


Figure 7 shows the OSLON® Compact CL packaged in tape and on reel. Removing the LED from the tape using simple tweezers must be avoided since this can cause damage to the housing due to forces on the side or edges of the silicone encapsulant.

Figure 7: OSLON® Compact CL Position of the LED in the tape — method of taping



When processing 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 to the package's characteristics. Since most products were tested with ASM SIPLACE pick and place machines, ASM SIPLACE nozzles are recommended. If other types of pick and place machines are used in the field, please use modified tools according to the given dimensions and body structure for the mounting. An example of a suitable pick-and-place nozzle design for damage-free processing is shown in Table 6. As a starting point, a placement force of ≤ 2N is recommended and should be minimized where possible.

Table 6: Recommended nozzles

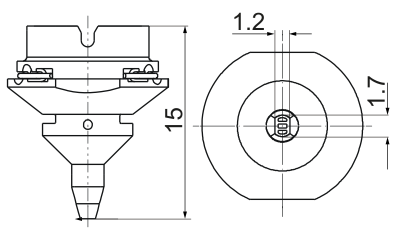
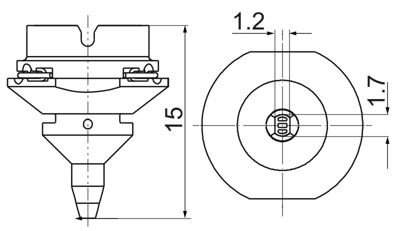
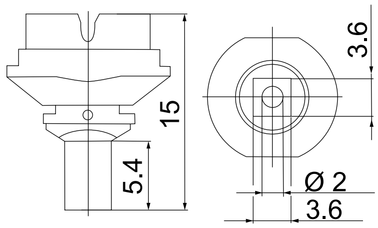
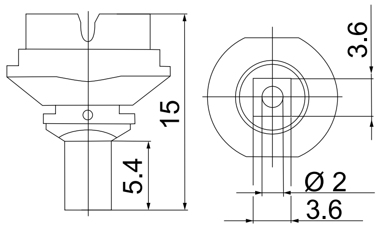
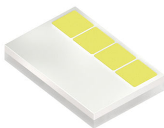
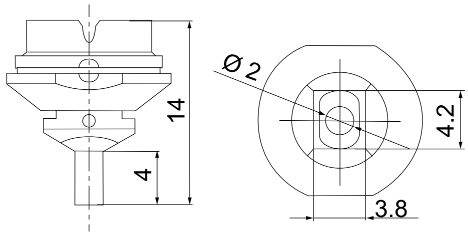
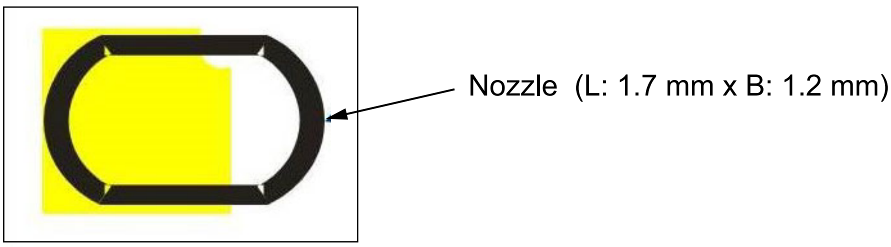
Product	Recommended nozzle design
OSLON® Compact CM LUW CEUN.CE 	SIPLACE 2004 
OSLON® Compact CL / OSLON® PL single / OSLON® Boost HM 	SIPLACE 2004 

Table 6: Recommended nozzles

Product		Recommended nozzle design
OSLON® Compact PL 2-Chip		SIPLACE 3124628 
OSLON® Compact PL 3-Chip		SIPLACE 3124628 
OSLON® Compact PL 4-Chip		SIPLACE 3110067-01 

If possible, the tool should pick up the LED across the entire surface or along the converter rim. Figure 8 show the pick-up area at the example of the OSLON® Compact CM. The same applies when depositing or placing the LED. Forces should be applied over the entire surface or along the converter rim.

Figure 8: OSLON® Compact CM: Recommended pick-up area for the SIPLACE nozzle #2004



The use of an unadapted tool (e.g. with too small dimensions) can lead to cracks or fracture of the encapsulation and bond wire damage, especially when placing the LED.

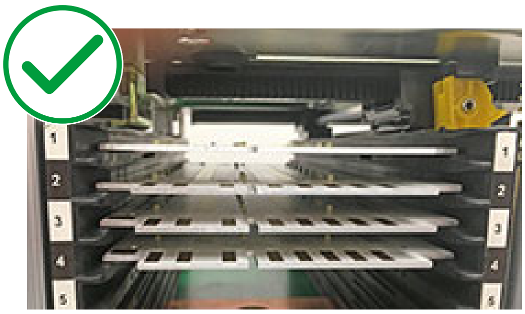
Please note even after being soldered on the PCB board any mechanical stress or touching of the embedding material must be avoided. Care should be taken as well to ensure that no other components (e.g. additional optics) in the application are mounted flush with the sensitive encapsulation of the LED. When placing the LED into operation, it should be ensured that sufficient cooling is provided. Depending on the given circumstances, extended operation without heat dissipation can lead to overheating, damage or failure of the component.

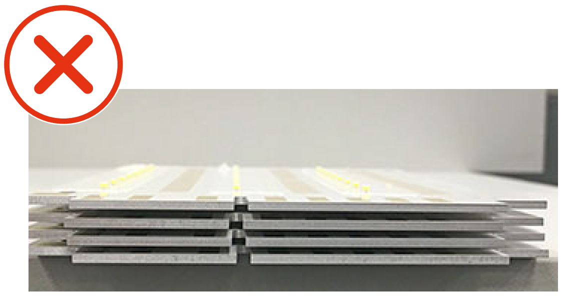
2.1 Storage

LEDs are generally supplied in tape with a dry pack and should stay factory-sealed when stored. This package should only be opened for immediate mounting and processing, after which the remaining LEDs should be repacked according to the moisture level in the data sheet (q.v. JEDEC J-STD-033B.1 - Moisture Sensitivity Levels). Please refer also to the application note "Fundamentals of LED handling" for more information, especially if long-term storage is desired.

PCBs or assemblies containing LEDs should not be stacked such that force is applied to the LED (Figure 7), or should not be handled directly at the LED. Generally, all LED assemblies should be allowed to return to room temperature after soldering, before subsequent handling, or the next process step.

Table 7: Storage of assemblies with LEDs





2.2 Cleaning

From today's perspective any direct mechanical, wet or chemical cleaning of the OSLON® Compact LEDs is forbidden. 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.

3 Processing

Generally, ceramic LEDs are compatible with existing industrial SMT processing methods, so that current populating techniques can be used for the mounting process. The individual soldering conditions for each LED type according to JEDEC can be found in the respective data sheets. Also the recommended solder pad designs can be found there.

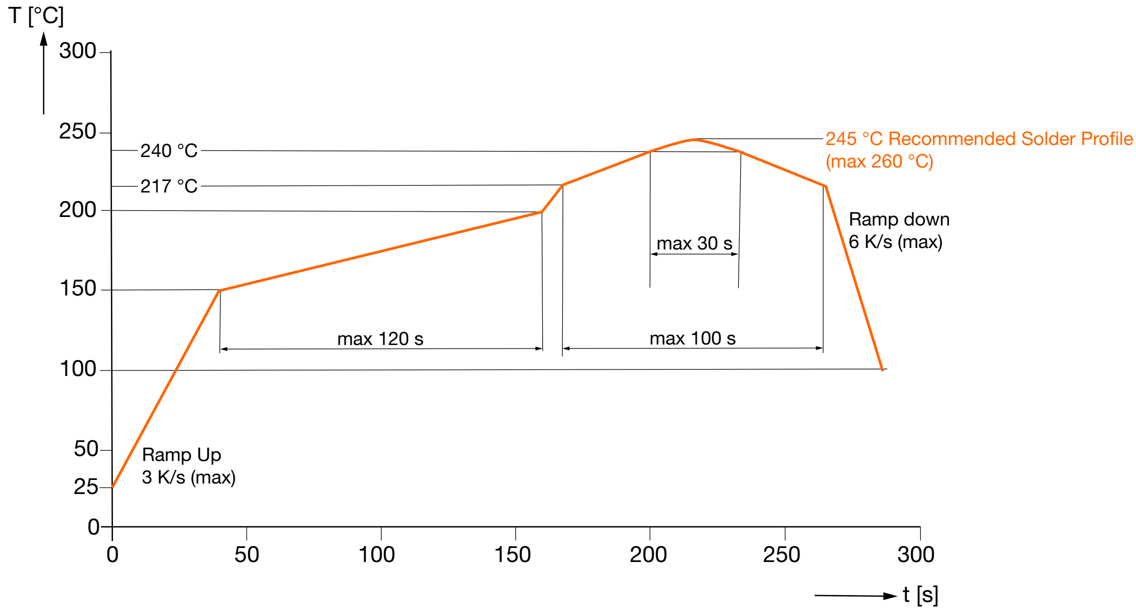
A standard reflow soldering process with forced convection under standard N_2 atmosphere is recommended for mounting the component, in which a typical lead-free SnAgCu metal alloy is used as solder. Figure 9 shows the temperature profile for lead-free soldering with the recommended peak temperature of 245 °C.

In this context, it is recommended to check the profile on all new PCB materials and designs. As a good starting point, the recommended temperature profile provided by the solder paste manufacturer can be used. The maximum temperature for the profile as specified in the data sheet should not be exceeded, however.

When developing the circuitry, special attention should be given to the position and orientation of the LED on the circuit board. Depending on the position and orientation of the LED, the mechanical stress on the LED can vary. In general, it is recommended that all twisting, warping, bending and other forms of stress to the circuit board should be avoided after soldering in order to prevent breakage of the LED housing or solder joints. Therefore, separation of the circuit boards should not be done by hand, but should exclusively be carried out with a specially designed tool.

For further information such as regarding PCB type, solder pad, solder stencil, voids, post reflow inspection and verification of the design please see also application notes “ Ceramic LEDs - Detais on handling and processing” and “Processing of SMD LEDs”.

Figure 9: Temperature profile for lead-free reflow soldering according to JEDEC JSTD-020



Profile Feature	Symbol	Pb-Free (SnAgCu) Assembly			Unit
		Min	Recommended	Max	
Ramp-up rate to preheat[1] 25 °C to 150 °C			2	3	K/s
Time t_S $T_S$min to $T_S$max	t_S	60	100	120	s
Ramp-up rate to peak[1] T_{Smax} to T_P			2	3	K/s
Liquidus temperature	T_L		217		°C
Time above liquidus temperature	t_L		80	100	s
Peak temperature	T_P		245	260	°C
Time within 5 °C of the specified peak temperature T_P - 5 K	t_P	10	20	30	s
Ramp-down rate[1] T_P to 100 °C			3	6	K/s
Time 25 °C to T_P				480	s

All the temperatures refer to the center of the package, measured on the top of the component
[1]slope calculation DT/Dt: Dt max. 5 s; fulfillment for the whole T-range

3.1 PCB material

In addition to its primary function as a mechanical fixture and electrical connecting element for the components, modern PCB‘s also serve to ensure stable conditions within the circuit and to provide efficient heat dissipation. The selection of appropriate materials for the circuit board is therefore of importance, especially as the total thermal resistance of the system should be as low as possible. Materials with insufficient thermal conductivity can lead to an impairment of reliability or restrict operation at optimal performance.

Depending on the total input power, along with the application conditions and requirements, various PCB materials are possible, such as:

o FR4 with thermal vias

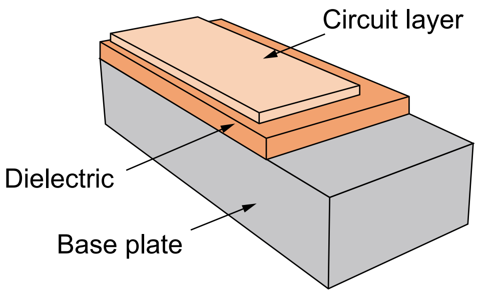
o Flexible PCB on metal base

o Insulated Metal Substrate (IMS-PCB)

o Ceramic substrate

The insulated metal substrate (IMS) consists of a metal base (d ≥ 1 mm) as base plate with a thin dielectric layer, usually in the range of 100 µm (see Figure 10). The heat is transmitted through the thin insulation layer (vertical heat conduction) to the metal carrier (usually aluminum). The metal carrier is then responsible for lateral heat distribution.

Figure 10: Typical layer construction of insulated metal substrate PCB (IMS)



Circuit layer (Cu)	35 µm
Dielectric thickness	100 µm
Dielectric thermal conductivity	0.8 -1.9 W/mK
Base plate (Al or Cu)	1.5 mm (typ.)

If an IMS (Insulated Metal Substrate) is used, the difference in the Coefficients of Thermal Expansion (CTE) between the LED and the IMS PCB must be considered. This may create a thermo-mechanical stress on the solder joint which can cause a accumulated damage that could result in cracks and loss of electrical contact. Therefore, it is important to ensure that the materials are correctly matched, especially for the 2 to 4 chip variants. Table 8 shows the CTE values of relevant PCB materials.

Table 8: CTE values of relevant PCB materials

Material	Coefficient of thermal expansion (CTE)
Aluminium (IMS)	24 ppm / K
FR4 (PCB)	17 ppm / K
Cu (IMS)	16 ppm / K
AIN (Package OSLON® Compact)	4 ppm / K

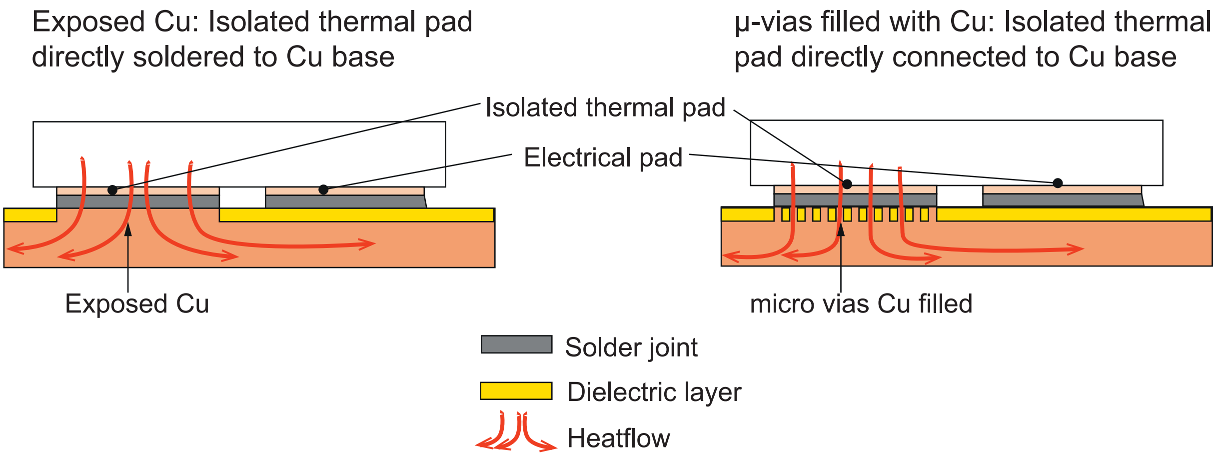
It may well be advisable to design and develop a low stress dielectric layer. The key is to find a moderate CTE mismatch between the LED and the PCB substrate, allowing the stresses to be absorbed by the low stress dielectric layer. To achieve a reliable solder joint, this should be done in cooperation with PCB manufacturers.

Please refer also to the application note "Ceramic LEDs - Detais on handling and processing" for more information.

3.1.1 Enhanced IMS PCB

This is an optimized variant of IMS circuit boards in which the copper partially protrudes through the isolation layer. The isolated thermal pad is directly connected to the Cu-base to bridge the dielectric at the thermal pad. It allows the heat to be dissipated directly without the need for insulation between the thermal pad, the metal layer and the heat sink.This can be achieved either by an exposed Cu pad or by µ-vias filled with Cu (see Figure 11). To use this heat dissipation in the design, the use of an LED with additional isolated thermal pad is necessary.

Figure 11: Thermal pads directly connected to Cu-base



4 Data Matrix Code

OSLON® Compact LEDs of the newer generation contain a unique Data Matrix Code (DMC) on the package. This contains the product classification and an unique unit-identification code. It can be used to trace the LED in production but does not contain any information other than the trace code and therefore no further information regarding the LED can be requested from ams-OSRAM AG.

5 Summary

Due to its design and small dimensions the manual handling and assembly of the OSLON® Compact is delicate especially with simple tweezers, since the LED must be picked and handled only at the very thin ceramic base. Please note that no mechanical impact on the encapsulant is allowed. In general it should also be kept in mind that the LED is not suitable for any direct mechanical, wet or chemical cleaning. The variety of LEDs with individual characteristics makes it possible to find the right LED for the application. It is important to ensure good thermal management by selecting the appropriate PBC. The CTE of the respective materials must be taken into account. Due to the individual DMC which can be found on many LEDs, a traceability in the production is also possible.

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

For further information and more details on this product family please scan this QR Code.

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