OSLON® Black Flat S - Details on handling and assembly

Application Note

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OSLON® Black Flat S

Abstract

The OSLON® Black Flat S family offers high efficiency and a thermal concept, which allows for cost optimization of the application. The LED enables headlamp applications with a heatsinkless approach and a reduced number of LEDs. This Application Note provides details on the handling and processing of OSLON® Black Flat S LEDs.

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1 Basic information

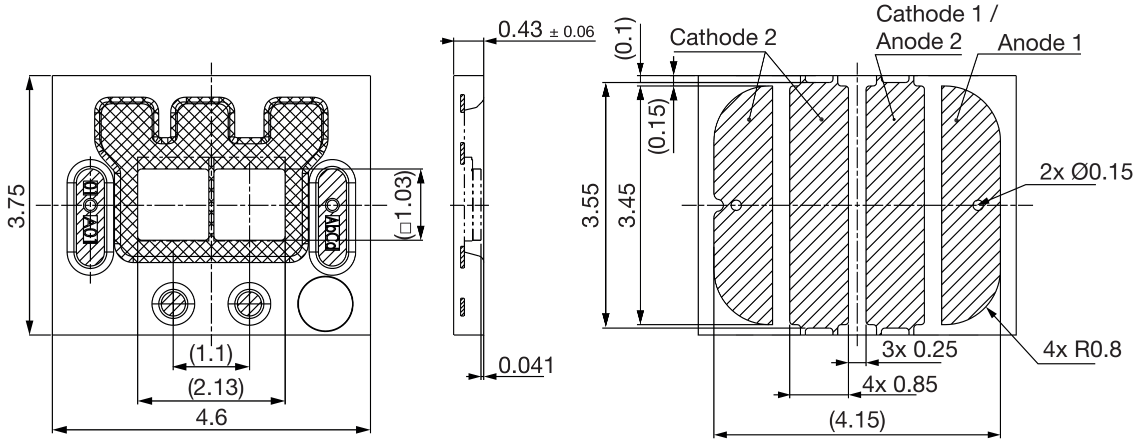
The OSLON® Black Flat S is a high brightness LED with a solder pad layout for enhanced thermal management enabling cost-efficient applications. A combination of chip efficiency and a low thermal resistance package results in a typical real thermal resistance, transition junction to the solder point, of 3.3 K/W (KW HHL532.TK) or 2.8 K/W (KW2 HIL532.TK) respectively. This allows the use of standard metal core boards in applications. Figure 1 shows an overview of the high-efficiency LEDs.

Figure 1: Overview of the high-efficiency OSLON® Black Flat S LEDs

1.1 Mechanical and optical design resources

Figure 2 shows the dimensional drawing of the KW2 HIL532.TK. For detailed information on the mechanical dimensions please refer to the drawings available in the respective data sheet. Detailed drawings or 3D-models are available on request.

Figure 2: Dimensional drawing of the KW2 HIL532.TK.



To obtain CAD data and optical rayfile, please visit the "Optical Simulation / Ray Files + Package CAD Data" webpage on the ams-OSRAM 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 3B. 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.

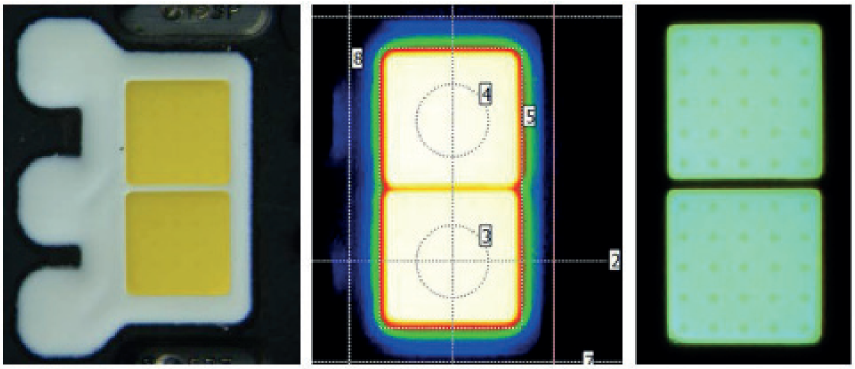
1.3 Thermal advantages

Due to the high light output at relatively low currents, the thermal design can be based on free convection cooling by sufficiently large dimensioned insulated metal substrate (IMS). This allows headlamp designs without a special heat sink. Various simulations were performed and are available on request. A document on the heatsinkless approach is available on request.

2 Light efficiency and optical design implementation

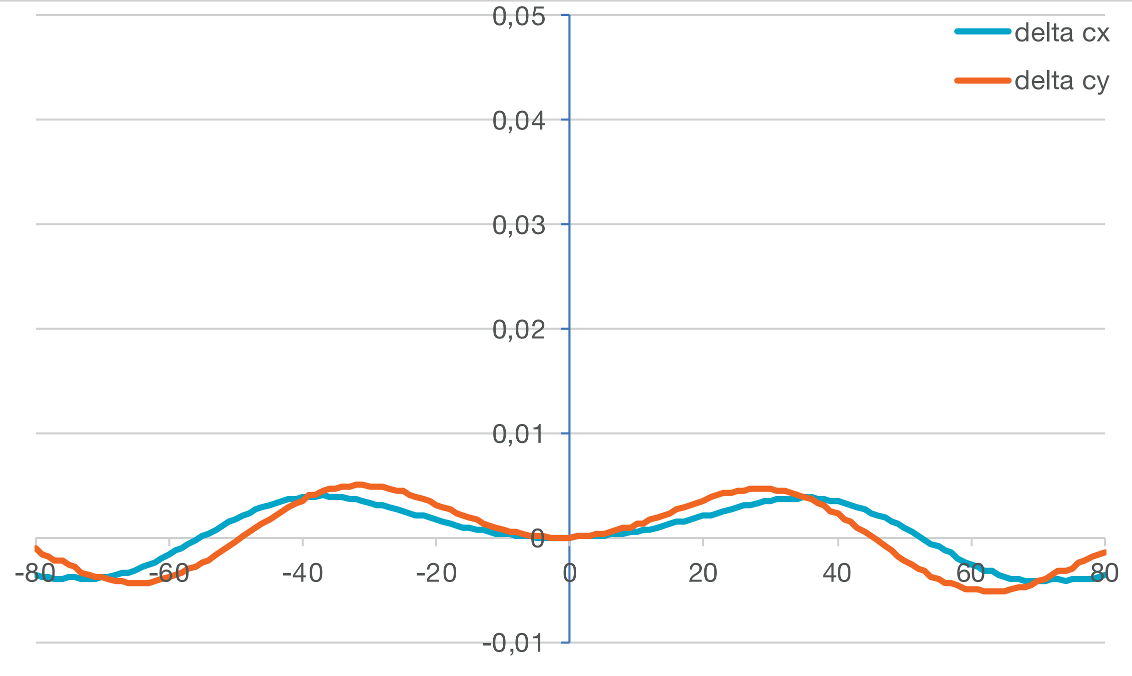
The LEDs are designed with the center of the light emitting surface (LES) corresponding to the geometrical center of the housing. The LES measures 1030 x 1030 µm² per chip and has a very good brightness-to-luminance ratio. The achieved contrast is more than 1:250 at a minimum distance from the edge of the emitting area. As shown in Figure 3 it is homogeneous in terms of both color and brightness.

Figure 3: Chip contrast and homogeneous color and brightness KW2 HIL532.TK



The color-over-angle characteristics have been significantly improved for these devices. Figure 4 shows the cx and cy over-angle behavior.

Figure 4: cx and cy over angle characteristic



Luminous intensity simulations for headlamp applications have been performed for the OSLON® Black Flat S series and are available on request.

3 Handling and assembly 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 LED failure. Whether defects occur or how robust an LED is in regard to certain stresses is product specific. 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 and the LED light emitting area should generally not be touched or punctured as this can damage the component.

As is the case for all LEDs from ams-OSRAM, the LED also fulfills the current RoHS guidelines (European Union and China) and therefore contains no lead or other substances defined as hazardous.

3.1 ESD stability

The LED provides ESD stability of up to 8 kV. It is assigned to the "HBM, Class 3B" 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”.

3.2 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.

3.3 Precautions and storage

For storage and dispatch, the reels 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 to ensure that assembled LED boards are not stacked on top of each other (Figure 5). 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 must not be touched directly by hand or other components. Generally, all LED assemblies should return to room temperature after soldering, before subsequent handling, or next process step.

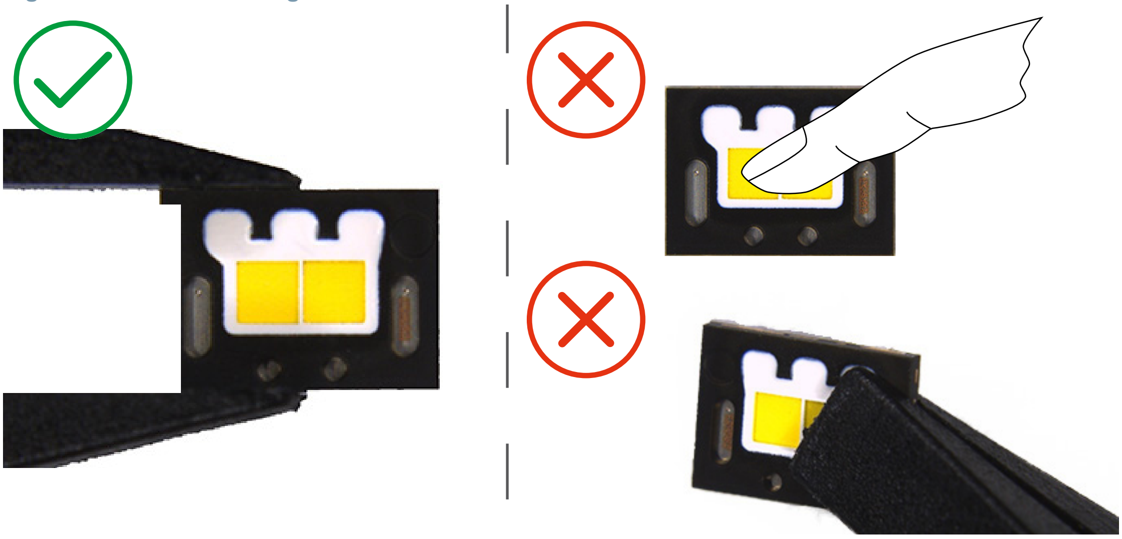
Figure 5: Correct storage

3.4 Manual 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 reduced as far as possible (see also application note "Fundamentals of LED handling"). 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. The LED must not be lifted from the top because this may cause damage 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 as shown in Figure 6.

Figure 6: Manual handling recommendations



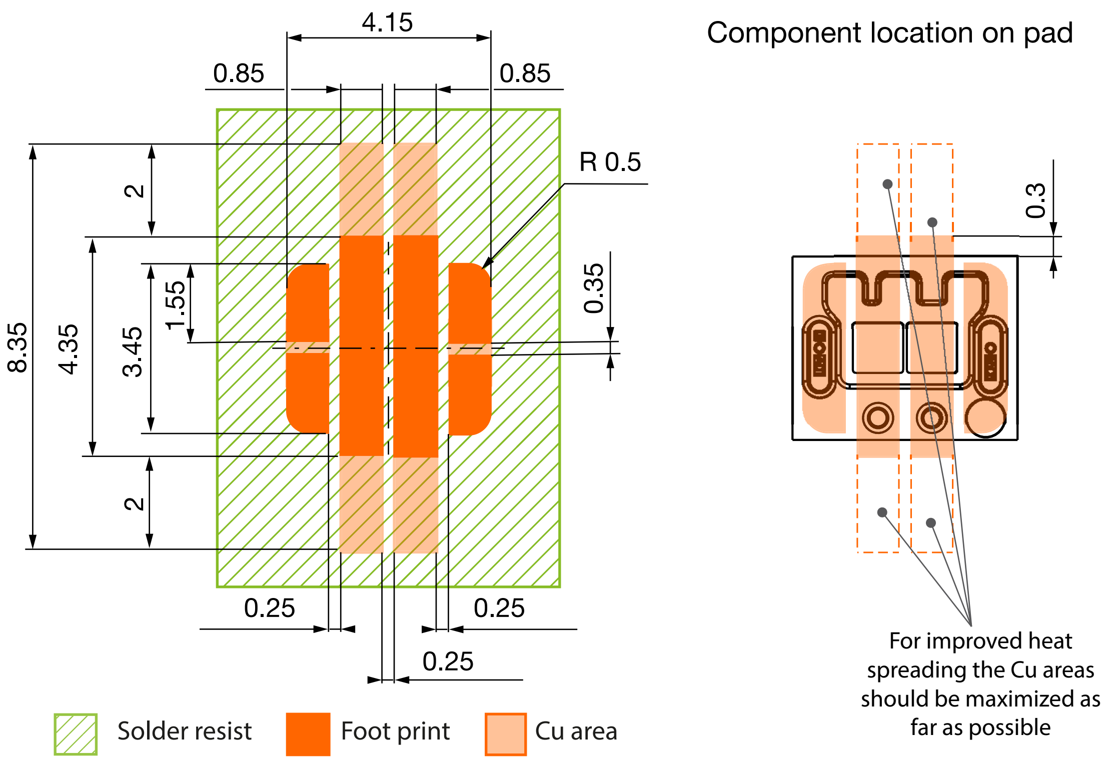
4 Processing

4.1 Solder pad design

Since the solder pad creates direct contact between the LED and the circuit board, the design of the solder pad contributes decisively to the performance of the solder connection. The design has an influence on solder joint reliability and heat dissipation.

In most cases, it is therefore advantageous to use the recommended solder pad, since it has been individually adapted to the properties and conditions of the LED. For improved heat spreading the Cu areas should be maximized as far as possible. The corresponding solder pad design can also be found in the data sheet of each LED. Figure 7 shows the recommended solder pad design for the KW2 HIL532.TK as an example.

Figure 7: Recommended solder pad design: Example KW2 HIL532.TK

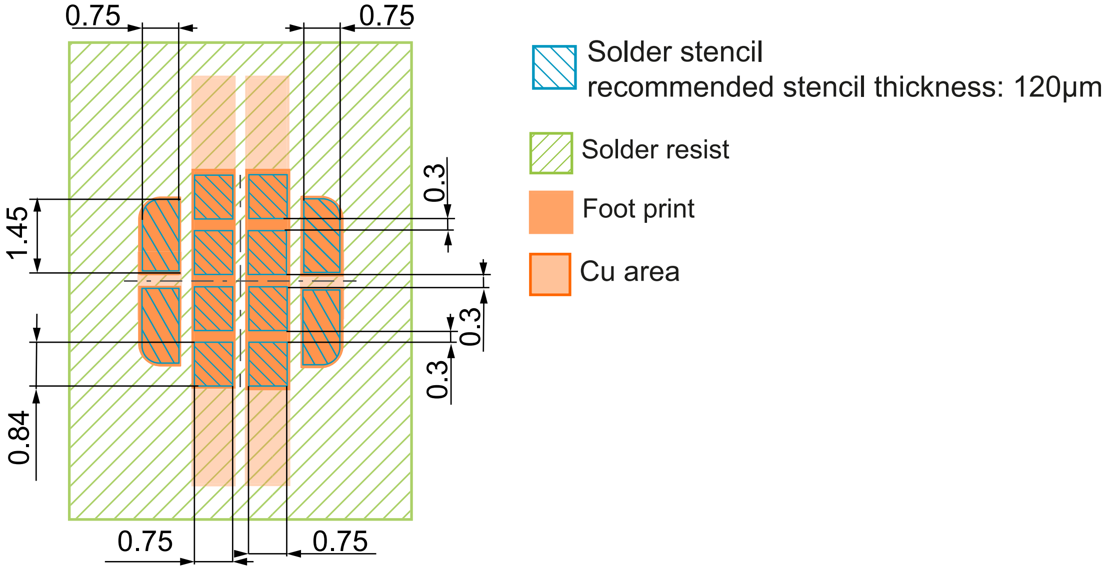


An optimized balance between good processability, the smallest possible positioning tolerance and a reliable solder connection can be achieved based on the solder pad design given.

4.2 Solder stencil

In the SMT process, solder paste is normally applied by stencil printing. The design of the printing stencil and an accurate working process influence the amount applied and the quality of the paste deposit (Figure 8).

Figure 8: Recommended solder stencil: Example KW2 HIL532.TK



Proper solder paste printing increases the solder quality. Effects such as solder bridges, solder spray and/or other soldering defects are largely determined by the design of the stencil apertures and the quality of the stencil printing (e.g. positioning, cleanliness of the stencil, etc.).

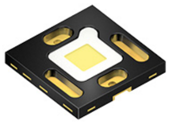
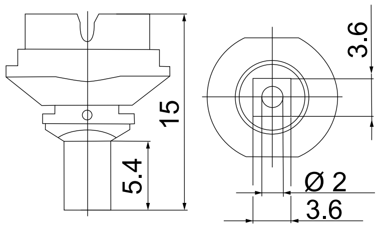
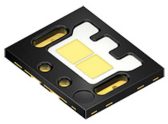
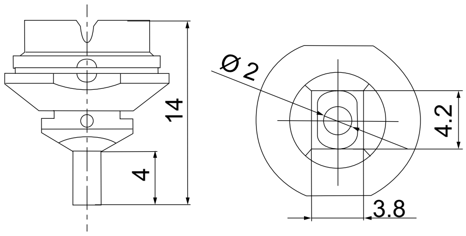
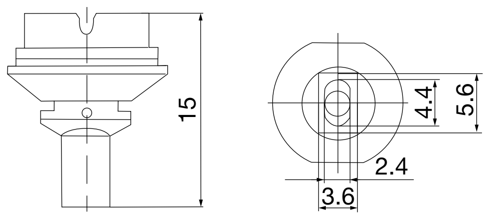
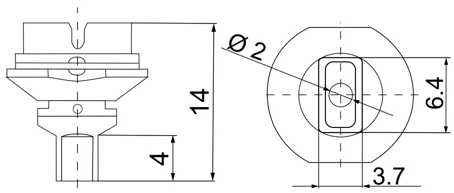
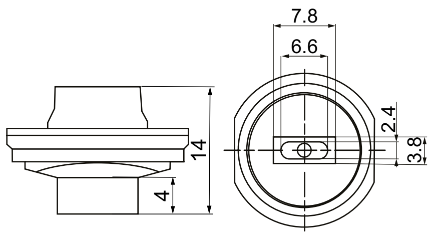
A stencil thickness of 120 µm for the LED is recommended. Further optimization to improve the amount of solder paste volume should take place. A uniform solder joint thickness is recommended in order to produce reliable solder joints and to obtain an appropriate optical alignment. Automatic stencil printing with proper fiducial and electro polished or a fine grain material stencil results in proper printing deposits.

The use of a standard lead free SAC 305 (Sn 96,5% / Ag 3% / Cu 0,5%) no clean solder paste for the paste printing process is recommended. ams-OSRAM has successfully used standard SAC 305 Type 3 solder paste (HERAEUS F640 SAC 305 M3). For process evaluation, process control and failure prevention it is recommended to check the solder paste volume with 3D SPI (Solder Paste Inspection) regularly.

4.3 Pick-and-place nozzle design

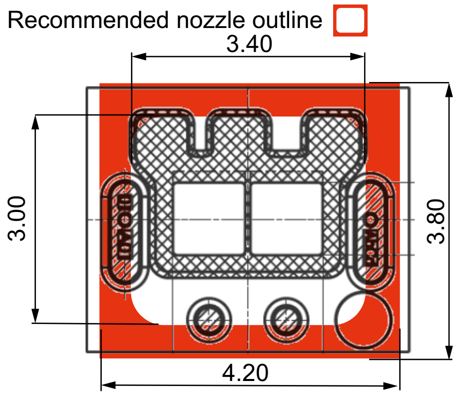
When processing by means of automated placement machines, care should be taken to use an appropriate pick-and-place tool and to ensure that the process parameters are comply with the package's characteristics. An example of a suitable pick-and-place nozzle is given in the form of the ASM SIPLACE tool in Table 1.

Table 1: Recommended pick-and-place nozzle

Product	Picture	Nozzle recommendation
OSLON® Black Flat S KW HHL532.TK KW HHL533.TK		SIPLACE 3124628 
OSLON® Black Flat S KW2 HIL532.TK KW2 HIL533.TK		SIPLACE 3110067 
OSLON® Black Flat S KW HJL531.TE KW3 HJL533.TK		SIPLACE 3081896 
OSLON® Black Flat S KW HKL531.TE KW4 HKL533.TK		SIPLACE 3271548 
OSLON®Black Flat S KW HLL531.TE		SIPLACE 3271553 

Care should generally be taken that an appropriate pick and place tool is used and that process parameters conform to package characteristics. As a starting point, a placement force of ≤ 2.4 N is recommended and should be minimized where possible. Since the LED was tested with ASM SIPLACE pick and place machines, 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. Figure 9 shows the recommended nozzle outline for the KW2 HIL532.TK as an example.

Figure 9: Recommended nozzle outline KW2 HIL532.TK

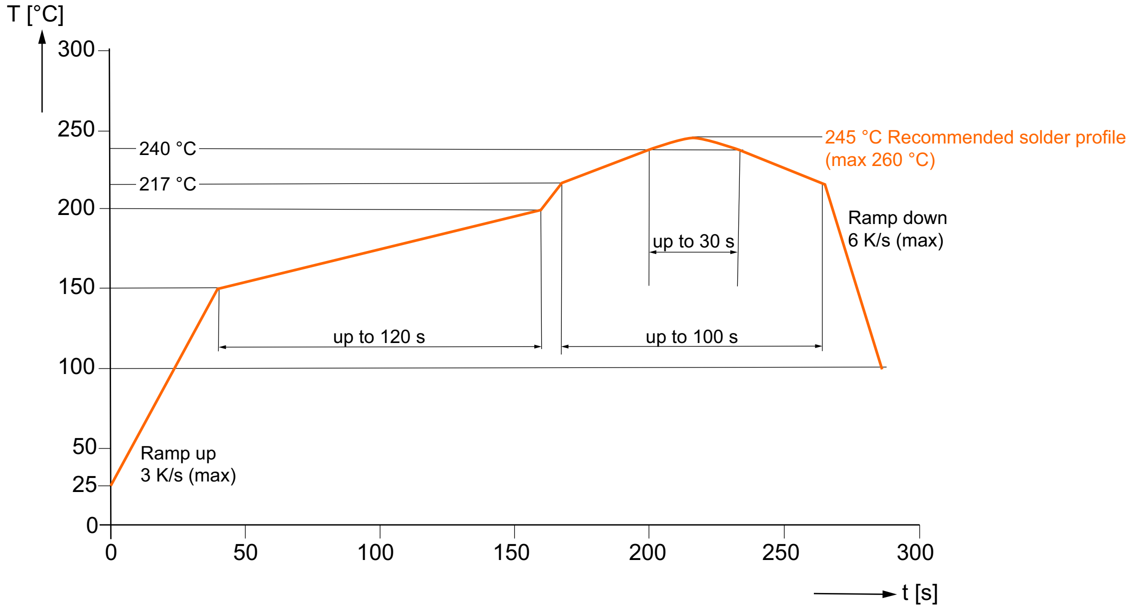


4.4 Reflow soldering

Since the LED is compatible with existing industrial SMT processing methods, state-of-the-art 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 sheet. A 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. For superior solder joint connectivity results it is recommended to use a nitrogen atmosphere <500 ppm O_2.

Figure 10 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 and also ramp-up and cool down gradient for the profile as specified in the data sheet should, however, not be exceeded. Please check and verify the reflow profile for every new design (see also application note "Measuring of the temperature profile during the reflow solder process"). Please ensure not to apply any stress during soldering or while the LED is cooling down to ambient temperature.

Figure 10: Recommended temperature profile for lead-free reflow soldering in accordance to JEDEC J-STD-020E



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

5 Summary

The OSLON® Black Flat S LEDs enable more cost-efficient headlamp applications.

Due to the combination of high chip efficiency together with a low thermal resistance package, a thermal design based on free convection cooling is possible. By using a sufficiently large dimensioned insulated metal substrate (IMS), a headlamp design without a special heat sink can be achieved.

The individual chips provide high brightness, with an excellent brightness-to-luminance ratio. The LED is homogeneous in terms of both color and brightness, achieving a contrast greater than 1:250 at a minimum distance from the edge of the emitting surface. In addition, the color-over-angle characteristic is good.

ABOUT ams OSRAM Group (SIX: AMS)

The ams OSRAM Group (SIX: AMS) is a global leader in intelligent sensors and emitters. By adding intelligence to light and passion to innovation, we enrich people's lives. 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 20,000 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 EUR 3.6 billion revenues in 2023. Find out more about us on https://ams-osram.com

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