OSCONIQ™ S Familiy - Details on handling and assembly

Application Note

Published by ams-OSRAM AG
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OSCONIQ™ S Familiy - Details on handling and assembly

Application Note No. AN139

Valid for:
OSCONIQ™ S 3030
OSCONIQ™ S 5050

Abstract

This document provides a comprehensive overview of the OSCONIQ™ S 3030 and OSCONIQ™ S 5050 LEDs from ams OSRAM highlighting their suitability lighting applications. It describes the design and key features of these LEDs, including guidelines for handling, assembly and solder pad design to enable effective implementation. 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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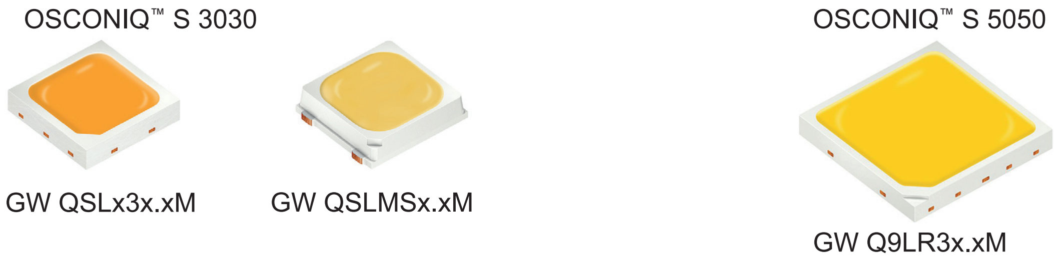
1 Basic overview

The OSCONIQ™ S product family (Figure 1) is ideal for professional indoor and outdoor lighting. It is suitable for applications like retail, office, architectural, and industrial lighting. OSCONIQ™

S 3030 LEDs set high standards for indoor lighting. The OSCONIQ™ S 5050 LED is perfect for outdoor and industrial use, focusing on performance, durability, and reliability.

Figure 1: OSCONIQ™ S product family

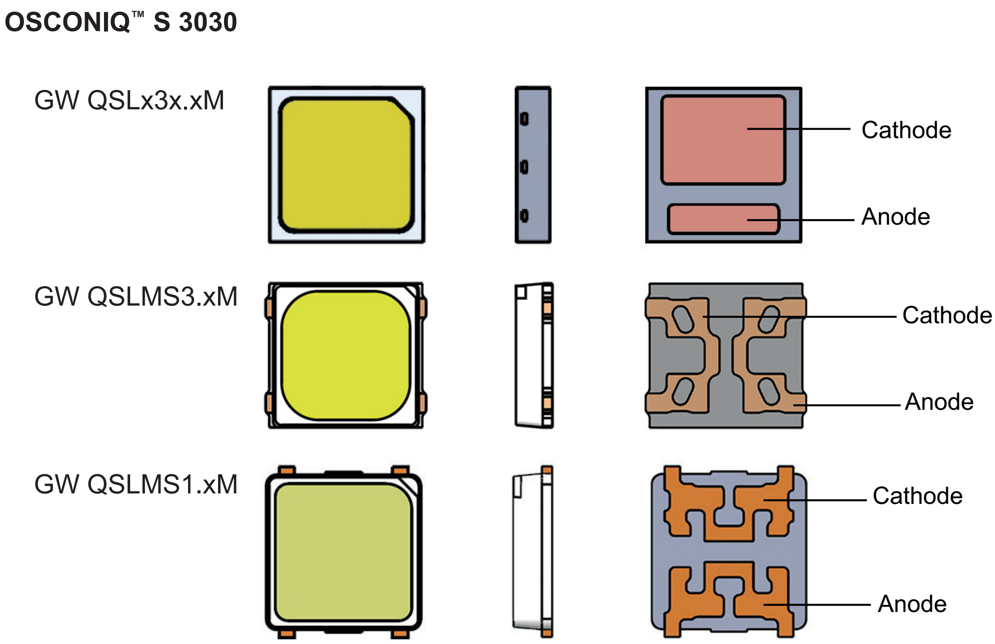


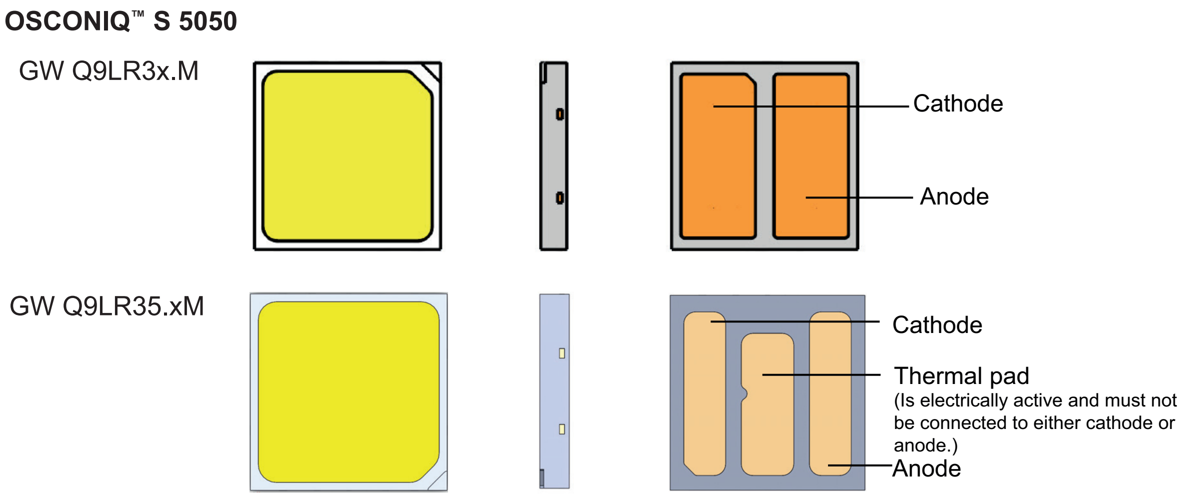
As is the case for all LEDs from ams OSRAM, the LED also fulfills the current RoHS guidelines (European Union and China) and therefore contains no lead or other substances defined as hazardous.

1.1 Features and design

The OSCONIQ™ S provides a good lifetime and reliability performance. An optimized phosphor, lead frame and chip design offers a good performance. The LED has low thermal resistance and a very good corrosion robustness. Figure 2 gives an overview on the different designs.

Figure 2: Design overview





2 Design considerations

2.1 Mechanical and optical design resources

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

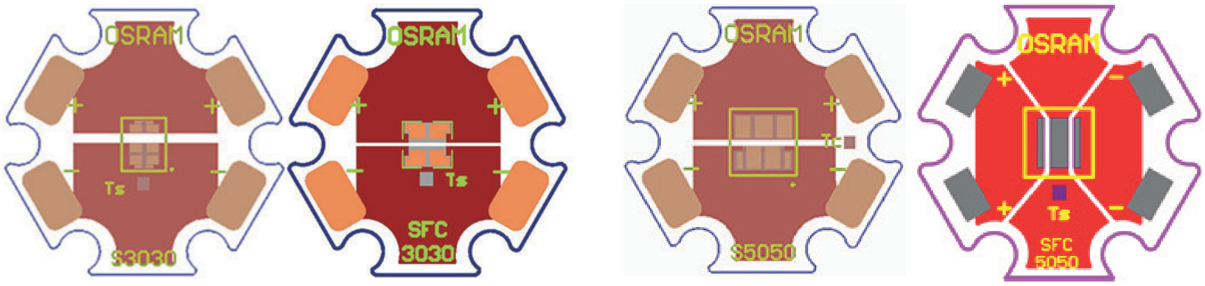
For more information on importing rayfiles and ray-measurement files, please refer to the application note "Importing rayfiles and ray-measurement files of LEDs".

2.2 Electrical connection

The OSCONIQ™ S 3030 consists of two electrical pads on the package an anode and cathode. The OSCONIQ™ S 5050 has an additional thermal pad (Figure 3). Therefore the clearance and creepage distance between the traces is critical to avoid flash-over or tracking between these electrical conductors. There are absolute maximum electrical rated values that are specified in the data sheet and each device must be operated below the maximum rated values in order to ensure its proper and reliable function.

Figure 3: PCB layout of single LED on MCPCB

OSCONIQ™ S 3030 OSCONIQ™ S 5050



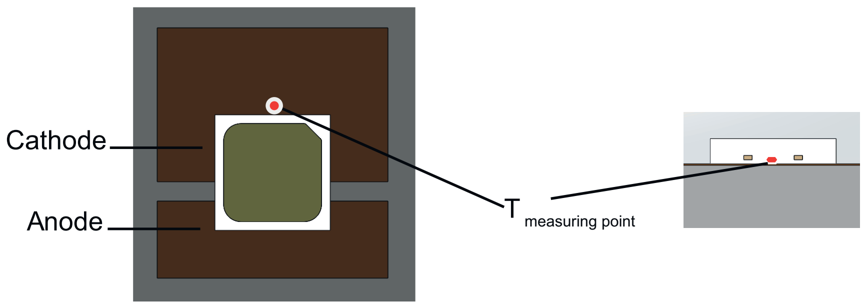
GW QSLx3x.xM GW QSLMSx.xM GW Q9LR3x.xM GW Q9LR35.xM

2.3 Thermal management

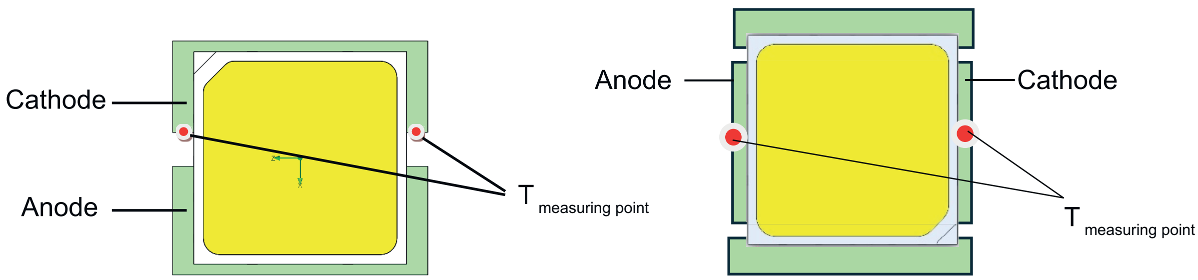
The thermal measurement needs to be performed right next to the LED which is the measuring point temperature, T_{mp} as shown in Figure 4.

Figure 4: Thermal measuring point temperature, T_{mp}

OSCONIQ™ S 3030



OSCONIQ™ S 5050



The T_{mp} of a predetermined location on the PCB in close contact to the LED is measured by a thermocouple. To ensure good heat transfer, use thermally conductive epoxy or solder. The thermocouple must directly contact the copper thermal pad. Any solder mask or similar must be removed before mounting the thermocouple onto the PCB copper pad.

Table 1 to Table 4 summarizes the thermal resistance values of the board and also T_J to T_{mp} between the various PCB designs and technologies.

Table 1: Simulation results for OSCONIQ™ S 3030 (GW QSLx3x.xM) R_{th} with various dielectrics and copper foils

PCB technology	Details	Cu foil	$R_{th\ sb\ el}$ (K/W)	$R_{th\ jmp\ el}$ (K/W)
Al-core MCPCB	38 µm dielectric (3.0 W/mK)	35 µm (1oz)	2.2	10.6
Al-core MCPCB	75 µm dielectric (2.2 W/mK)	35 µm (1oz)	3.7	11.0
Al-core MCPCB	100 µm dielectric (1.3 W/mK)	35 µm (1oz)	5.9	11.6
FR4 (capped vias)	vias on thermal pad	70 µm (2oz)	8.6	12.0
FR4 (open vias)	vias on thermal pad	70 µm (2oz)	13.8	15.6

Table 2: Simulation results for OSCONIQ™ S 3030 (GW QSLMSx.xM) R_{th} with various dielectrics and copper foils

PCB technology	Details	Cu foil	$R_{th\ sb\ el}$ (K/W)	$R_{th\ jmp\ el}$ (K/W)
Al-core MCPCB	38 µm dielectric (3.0 W/mK)	35 µm (1oz)	2.1	8.6
Al-core MCPCB	75 µm dielectric (2.2 W/mK)	35 µm (1oz)	3.0	8.8
Al-core MCPCB	100 µm dielectric (1.3 W/mK)	35 µm (1oz)	4.3	18.8

Table 3: Simulation results for OSCONIQ™ S 5050 (GW Q9LR3x.xM) R_{th} with various dielectrics and copper foils

PCB technology	Details	Cu foil	$R_{th\ sb\ el}$ (K/W)	$R_{th\ jmp\ el}$ (K/W)
Al-core MCPCB	38 µm dielectric (3.0 W/mK)	35 µm (1oz)	0.51	2.01
Al-core MCPCB	38 µm dielectric (3.0 W/mK)	70 µm (2oz)	0.49	1.99
Al-core MCPCB	75 µm dielectric (2.2 W/mK)	35 µm (1oz)	0.88	2.38
Al-core MCPCB	100 µm dielectric (1.3 W/mK)	70 µm (2oz)	1.54	3.04

Table 4: Simulation results for OSCONIQ™ S 5050 (GW Q9LR35.xM) R_{th} with various dielectrics and copper foils

PCB technology	Details	Cu foil	$R_{th\ sb\ el}$ (K/W)	$R_{th\ jmp\ el}$ (K/W)
Al-core MCPCB	38 µm dielectric (3.0 W/mK)	35 µm (1oz)	0.6	2.1
Al-core MCPCB	75 µm dielectric (2.2 W/mK)	35 µm (1oz)	1.0	2.2
Al-core MCPCB	100 µm dielectric (1.3 W/mK)	35 µm (1oz)	1.8	2.4

The typical thermal resistance $R_{th\ jmp}$ (Figure 5) between the junction and the measuring point for the OSCONIQ™ S can be obtained from the table above. With this information, the junction temperature, T_J can be calculated according to the following equation:

$$T_J = T_{mp} + I_F \bullet V_F \bullet R_{th\ jmp\ el}$$

Where:

T_J is the junction temperature of the LED [°C[

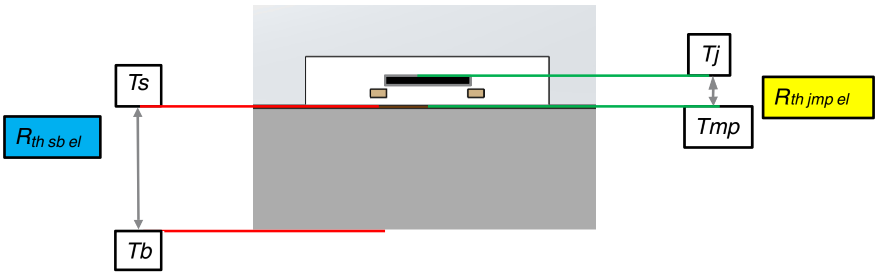
T_{mp} is the measuring point temperature on the PCB [°C]

I_F is the forward current of the system [A]

V_F is the forward voltage of the system [V]

$R_{th\ jmp\ el}$ is the thermal resistance of the LED according to the data sheet [K/W]

Figure 5: R_{th} network for OSCONIQ™ S



2.4 Chemical considerations

The LEDs offer high corrosion robustness. However, the optical performance and stability may be affected by chemical reactions with incompatible materials used in potting, coating, soldering, adhersion, etc. Always choose materials that are compatible with the LEDs. Especially when installing luminaire systems, it must be ensured that the LEDs do not get into contact with incompatible chemicals. Avoid air-tight designs to allow any chemical out-gassing to escape.

For further information please refer to the application notes “Chemical compatibility of LEDs” and “Preventing LED failures caused by corrosive materials”.

3 Handling recommendations

LEDs are exposed to various mechanical stresses during processing and in application. Each mechanical stress has direct effects on the functionality and lifetime of the LED. Excessive stress may lead to defects. The occurrence of defects or the robustness of an LED under 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, as this can damage the component. The LED light-emitting area should generally not be touched or punctured as this can cause damages.

3.1 ESD stability

The OSCONIQ™ S 3030 provides ESD stability of up to 5 kV in accordance with ANSI / ESDA / JEDEC JS-001. The OSCONIQ™ S 5050 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 LEDs 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 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.

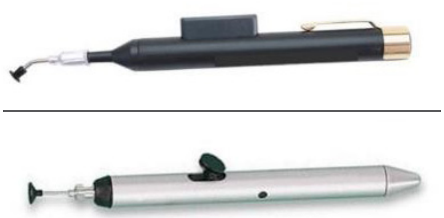
Figure 6: Correct storage

3.4 Manual handling

It is important to follow general guidelines when handling LEDs. Mechanical stresses (e.g., shear forces) on the elastic silicone encapsulation should be avoided or reduced whenever possible (see also application note "Fundamentals of LED handling"). In general, all types of sharp objects (e.g., forceps, fingernails, etc.) should be avoided to prevent stress to or penetration of the encapsulation, as this can impair the component.

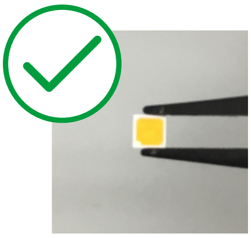
Automated placement of the LEDs is strongly recommended. Even if manual handling and mounting is possible, it should be avoided. Special care must be taken if manual handling is necessary. For manual assembly and placement – in the production of prototypes, for example — the use of so-called vacuum tweezers is recommended (Figure 7). The mechanical stress on the LED will be minimized by the use of a suitable soft rubber suction tip.

Figure 7: Examples of vacuum styluses

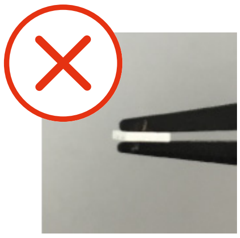


If there is no alternative to the exceptional use of tweezers (anti-static), the LED must be picked and handled only at the epoxy mold compound.

Figure 8: Manual handling of LED



Pick the LED only on the sides towards the bottom



Do not touch the silicone encapsulation

4 Processing

4.1 PCB type

PCBs are not only a mechanical substrate and electrical contact element for the components, state-of-the-art circuit boards should also ensure stable temperature characteristics of the circuitry. Efficient heat dissipation is therefore required and the selection of appropriate materials and designs for the circuit board is important.

Materials or composites with an insufficient thermal capacity and/or conductivity can lead to a loss of reliability and/or result in limited operating parameters, since the heat generated may not be sufficiently dissipated. With an increasing duty cycle of the application, proper thermal design and management is paramount.

The junction temperature T_J of the LED is the relevant parameter for judging the suitability of the thermal design. The maximum allowed junction temperature T_{J_max} can always be found in the data sheet and should not be exceeded during operation. For further information please refer to the application note “Thermal management of LED light sources”.

4.2 Solder pad and solder stencil design

Since the solder pad effectively creates the direct contact between the LED and the circuit board, the design of the solder pad contributes decisively to the performance of the solder connection.

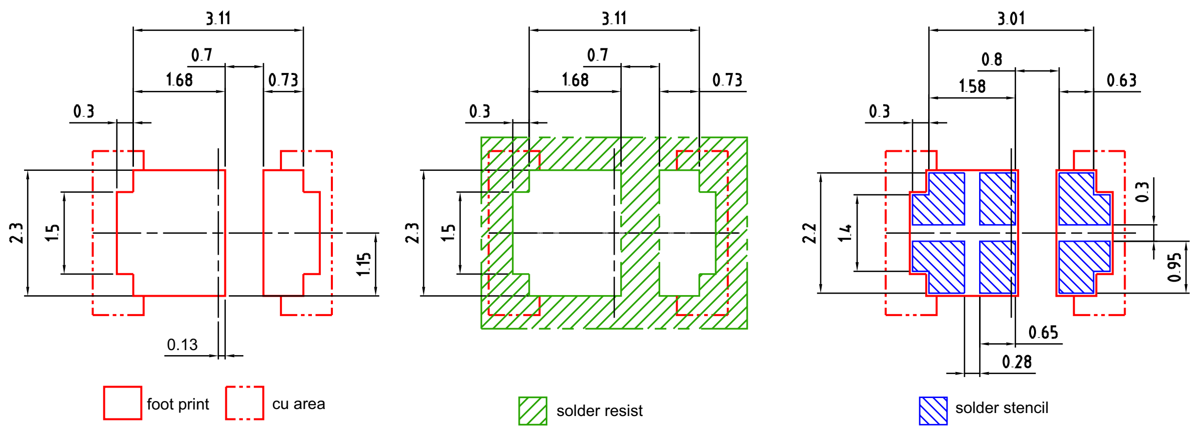
The design has an influence on solder joint reliability and heat dissipation.

In most cases, it is therefore advantageous to use the recommended solder pad, since it is individually adapted to the properties and conditions of the LED. 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 applied amount and quality of the paste deposit. The corresponding solder pad and solder stencil (Figure 9) can also be found in the data sheet of each LED.

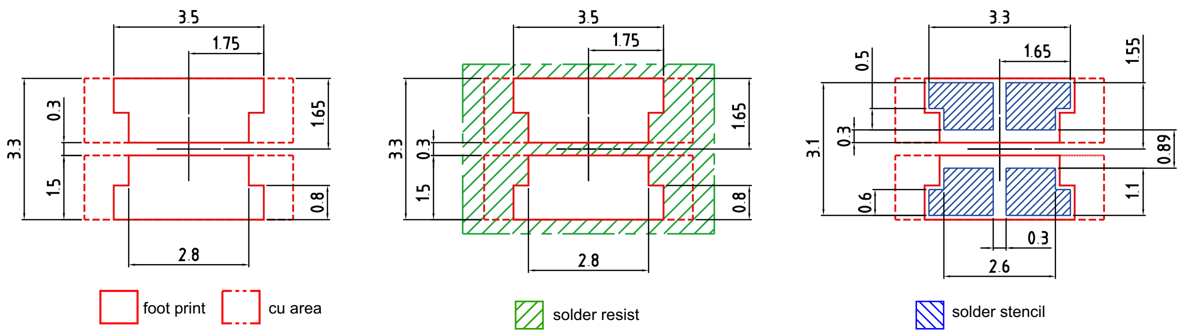
Figure 9: Recommended solder pad and solder stencil design

OSCONIQ™ S 3030

GW QSLx3x.xM

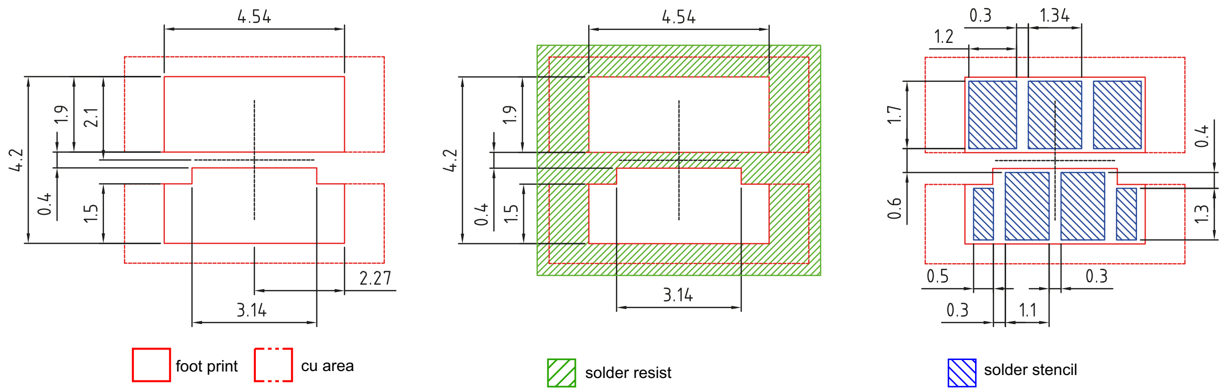


GW QSLMSx.xM

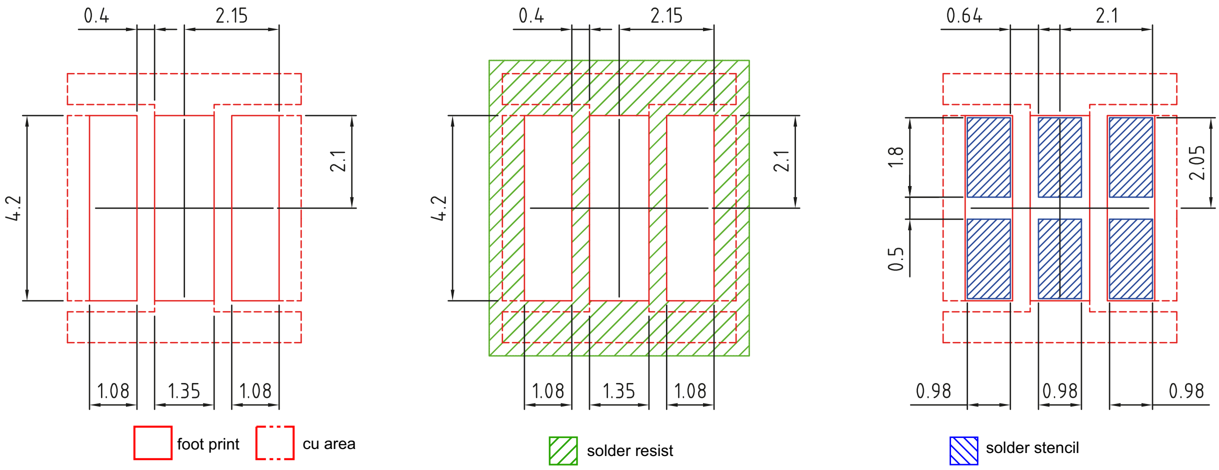


OSCONIQ™ S 5050

GW Q9LR3x.xM



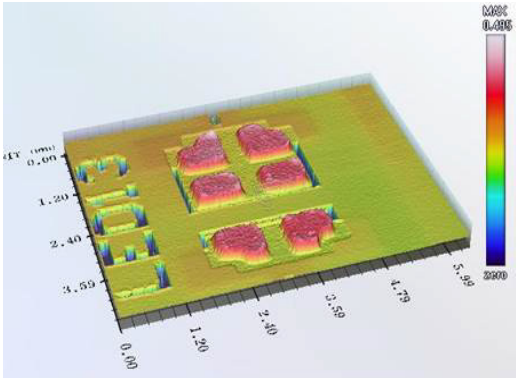
GW Q9LR35.xM



Based on the given solder pad design, an optimized balance between good processability, the smallest possible positioning tolerance and a reliable solder connection can be achieved. In general, the requirements for good thermal management should be taken into consideration in the application when designing the solder pads. In the end, this means that when designing the solder pads, the copper area should be kept as large as possible. This serves to dissipate and spread the heat generated over the PCB and is typically covered with a layer of solder resist.

A 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.). For the LED a stencil thickness of 120 µm is recommended. Further optimization to improve the amount of solder paste volume should take place. A uniform solder joint thickness is recommended to produce reliable solder joints and obtain an appropriate optical alignment. Automatic stencil printing with proper fiducials and electro-polished or fine-grain material stencils results in accurate printing deposits. However, the stencil thickness used may also depend on the other SMD components on the PCB. Figure 10 shows a 3D image for 120 µm solder paste.

Figure 10: 3D image for 120 µm solder paste print

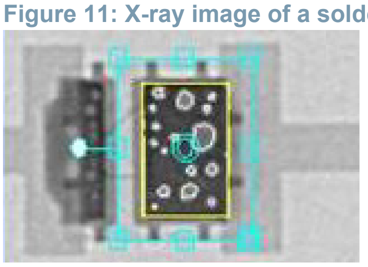


4.3 Voids

For a good thermal connection and a high board level reliability, it is recommended that voids and bubbles should be eliminated in all solder joints. The total elimination of voids, particularly for the larger thermal pad, is difficult. Therefore, the design of the stencil aperture is crucial for the minimization of voids. The recommended design openings in the stencil enable the out-gassing of the solder paste during the reflow soldering process and also serve to regulate the final solder thickness. Therefore, a typical solder paste coverage of 60 % – 80 % is recommended.

In industry standards such as IPC-A-610 D or J-STD-001D (which only refer to surface mount area array components such as BGA, CSP, etc.) the amount of voids (verified by the x-ray pattern) should be less than 25 %.

Figure 11: X-ray image of a solder joint of OSCONIQ™ S 3030

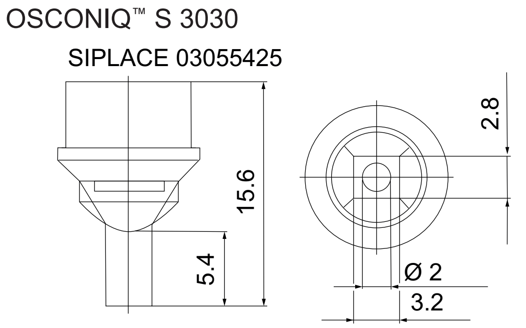


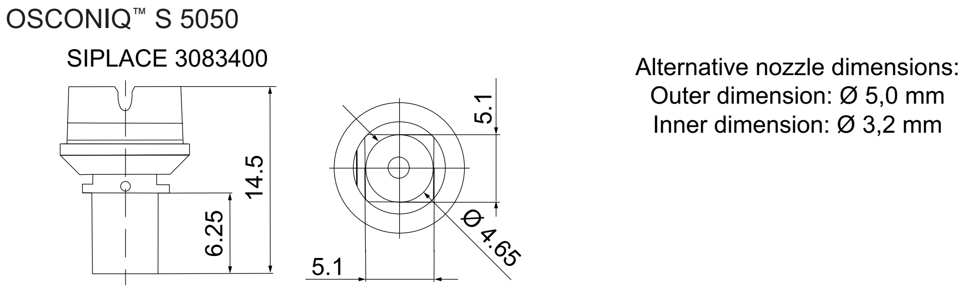
The limit of the acceptable voiding can vary for each application and depends on the power dissipation and the total thermal performance of the system, which is effected by the PCB materials used.

4.4 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 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 Figure 12. The placement force applied to the top of the package should be kept to minimum. For example, it can be tested with the standard default setting (2.0 N in most cases) at the beginning and should be then further reduced, if possible.

Figure 12: Recommended pick-and-place tools





If a stickiness issue occurs during pick-and-place operations, it is recommended to use nozzle heads made of the following materials to overcome the problem:

- Conductive Delrin
- Polyurethane (PU)

The use of a vision system is recommended for a good placement result. When setting up the machine, the package image should be configured for the pick-and-place process.

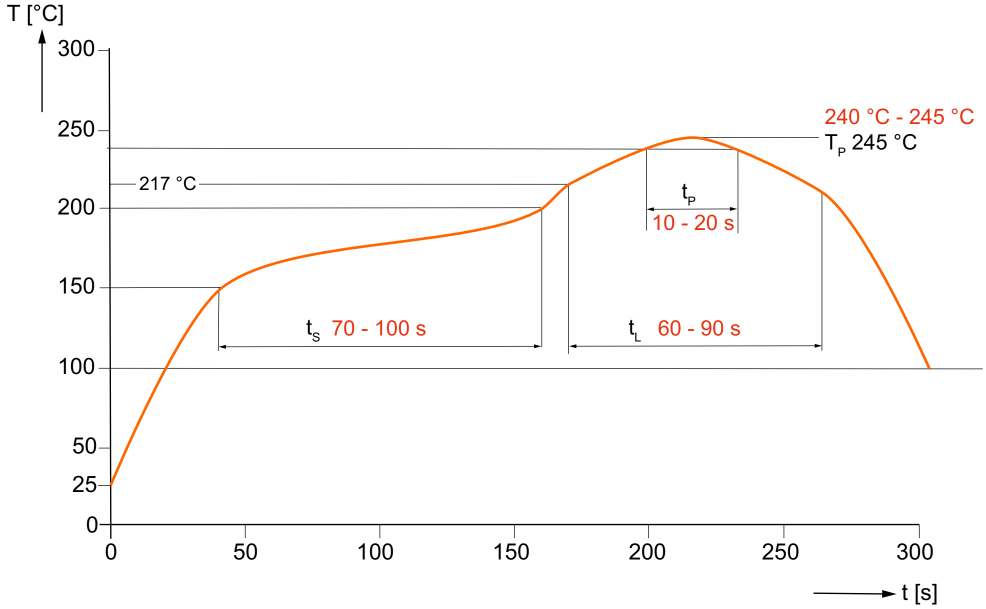
4.5 Reflow soldering

Since the LED is compatible with existing industrial SMT processing methods, state-of-the-art populating techniques can be used for the assembly process. The individual soldering conditions for each LED type according to JEDEC can be found in the respective data sheet. A typical lead-free SnAgCu metal alloy as solder is recommended for mounting the component. A standard reflow soldering process with forced convection under standard N_2 atmosphere should be used.

It is recommended to check and verify the temperature profile on all new PCB materials and for every new design (see also application note “Measuring of the temperature profile during the reflow solder process”). As a good starting point, the recommended temperature profile provided by the solder paste manufacturer can be used. The absolute 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 ensure not to apply any stress during soldering or while the LED is cooling down to ambient temperature.

To ensure good quality of solderability for OSCONIQ™ S 5050 (GW Q9LR35.xM) device, it is strongly recommended to follow the setting parameter as highlight in red in Figure 13.

Figure 13: Recommended temperature profile for OSCONIQ™ S 5050 (GW Q9LR35.xM)



5 Application support

My Luminator is an online tool that simplifies luminaire design by selecting the appropriate LEDs and their parameters. It assists engineers and lighting designers in finding products from ams OSRAM that optimally fit the needs of their luminaire designs. The interface is user-friendly, easy to handle, and enables quick initiation of the light source selection process. Only minimal information is required to start comprehensive planning and achieve good results with essential output. For more information on My Luminator, click here.

6 Summary

The process recommendations described in this application note should be followed.

The soldering result is influenced by several complex factors, including PCB construction, solder paste coverage, reflow conditions, and solder pad design. The solder pad design is critical for the performance, reliability, and heat dissipation of the solder connection. It is beneficial to use the recommended solder pad design, which is specially adapted to the properties of the LED.

Automated placement machines with appropriate tools should be used. LEDs are compatible with standard SMT methods, using a lead-free SnAgCu alloy and a reflow process under N_2 atmosphere. The temperature profile should be checked for each new design. Visual and X-ray inspections ensure solder joint quality and identify defects.

An adequate ESD protection must be ensured during handling. In general, mechanical stress on the LED during handling and processing should be kept to the minimum necessary.

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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