SFH 7018 - Details on handling and processing

Application Note

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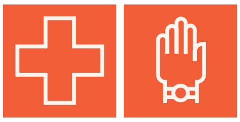
SFH 7018 - Details on handling and processing

Application Note No. AN114



Valid for:
SFH 7018A
SFH 7018B

Abstract

The SFH 7018A and SFH 7018B is a MULTILED® with a green, red and infrared emitter, developed for digital diagnostic and vital sign monitoring applications. This Application Note provides recommendations for proper handling and assembly. 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 information

The MULTILED® SFH 7018 is an optimized 3 in 1 solution. Red and IR are on the same axis and thus have the same distance to the detector. The SFH 7018 has two cavities, which provide a well-defined optical emission area. The side emission is also reduced. This MULTILED® is available in two variants. Variant A offers better V_f for high efficiency, while variant B has optimized brightness.

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".

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

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. 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. 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”.

2.1 ESD stability

The LED provides an ESD stability up to 2 kV. It is assigned to the “Class 2 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 1). 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.

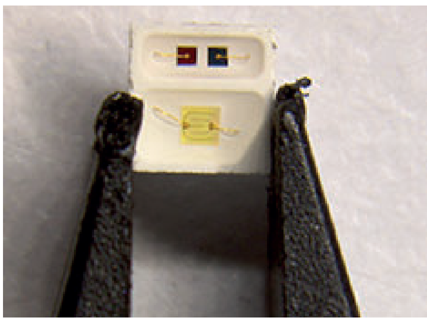
Figure 1: Correct storage

2.4 Manual handling

When handling LEDs, the general guidelines must be observed. Mechanical stress (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. Special care must be taken if manual handling is necessary. It is recommended to hold the LED package by using tweezers and applying the force equally to the entire LED package.

Figure 2: Recommended manual handling



3 Processing

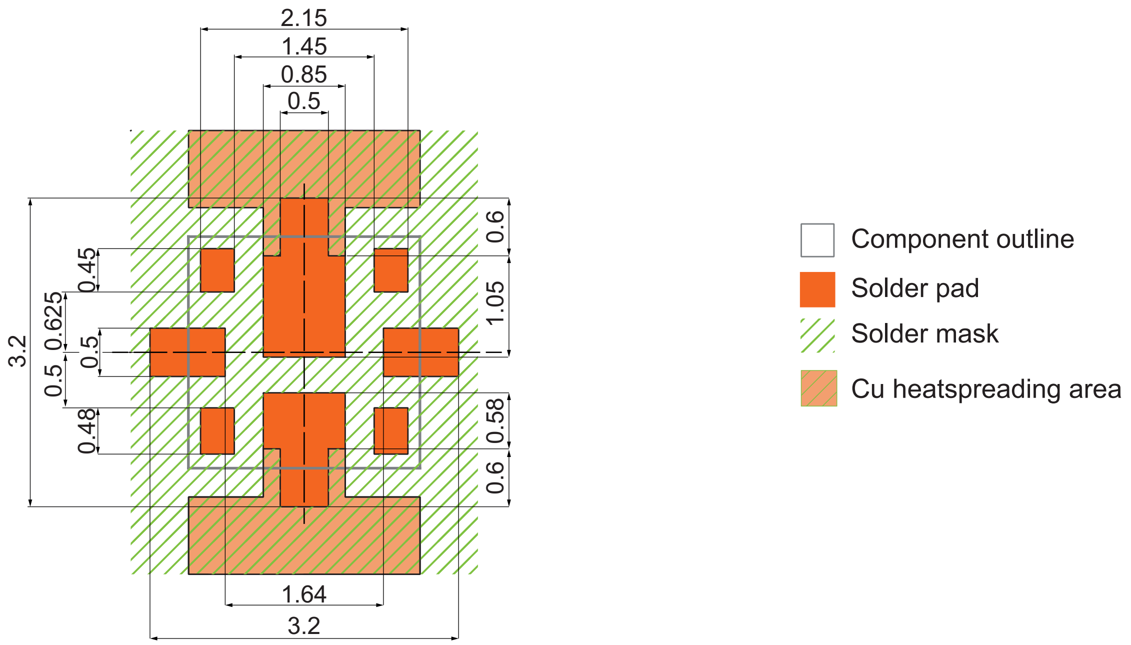
3.1 Solder pad design

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.

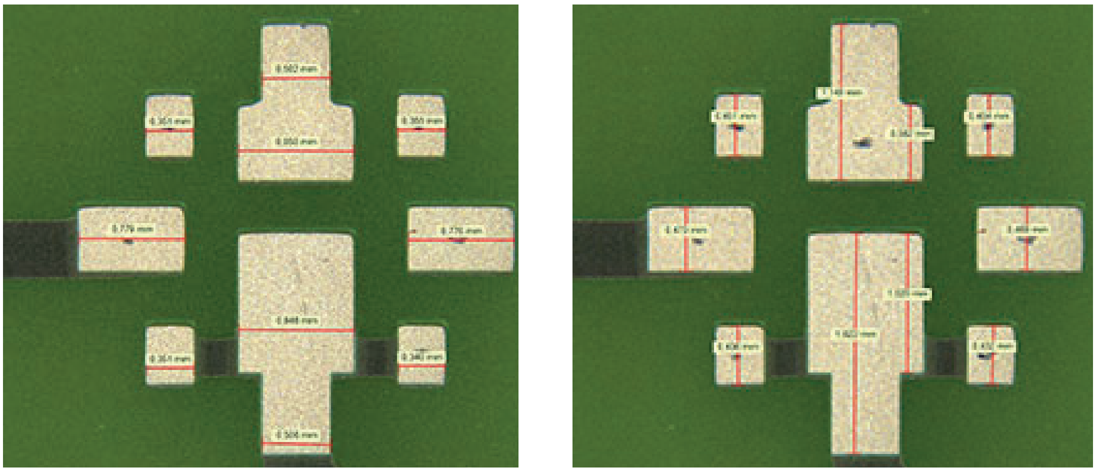
In most cases, it is therefore advantageous to use the recommended solder pad, since it is individually adapted to the properties and conditions of the LED (Figure 3). The corresponding solder pad can also be found in the data sheet of each LED.

Figure 3: Recommended solder pad design



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. It is recommended to check and re-measure the solder pad dimensions (Figure 4) of the PCB before processing.

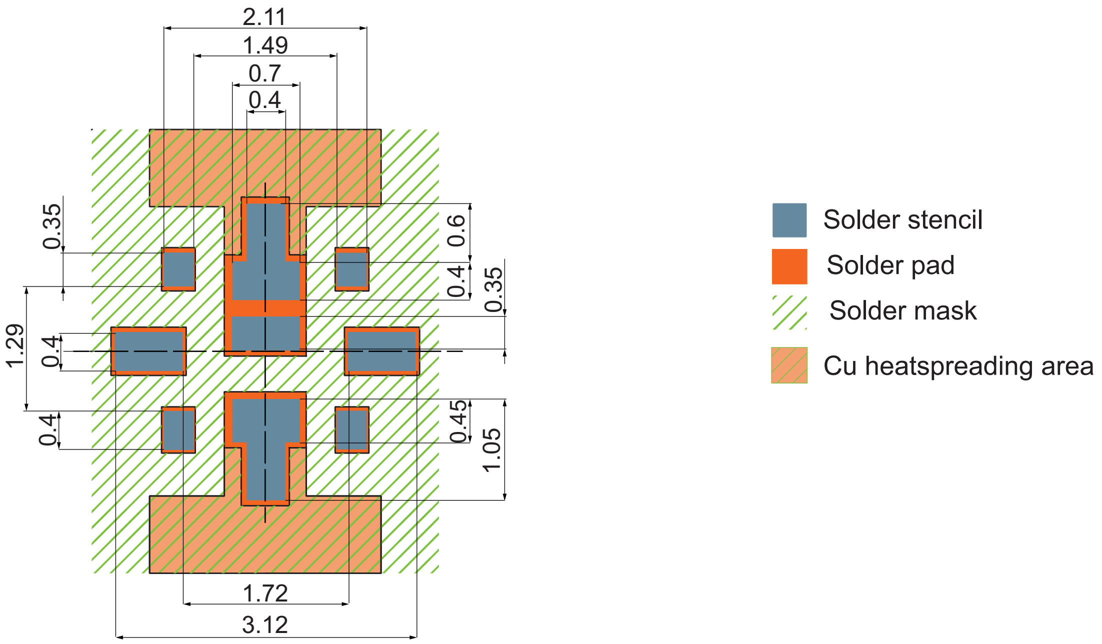
Figure 4: Verifying the solder pad design before processing



3.2 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 applied amount and quality of the paste deposit (Figure 5).

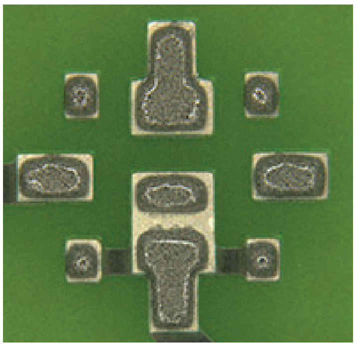
Figure 5: Recommended solder stencil



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 100 μm 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 obtain an appropriate optical alignment. An automatic stencil printing with proper fiducial and electro polished or fine grain material stencil is resulting in proper printing deposits.

Use standard lead free SAC 305 (Sn 96,5% / Ag 3% / Cu 0,5%) no clean solder paste for the paste printing process. ams-OSRAM AG has successfully used the standard SAC 305 Type 4 solder paste (HERAEUS F640 SAC 305 M4). For process evaluation, process control and failure prevention it is recommended to check the solder paste volume with 3D SPI (Solder Paste Inspection) regularly. Figure 6 shows a proper solder paste print.

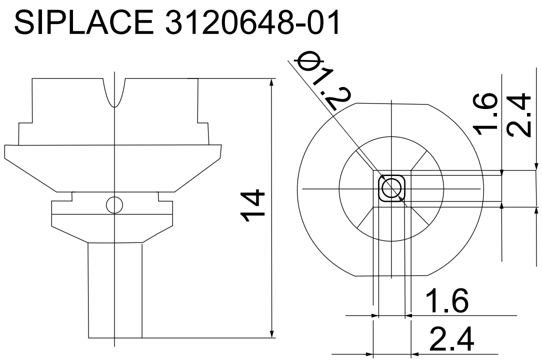
Figure 6: Proper solder paste print



3.3 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 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 7. 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 7: Recommended pick-and-place tools

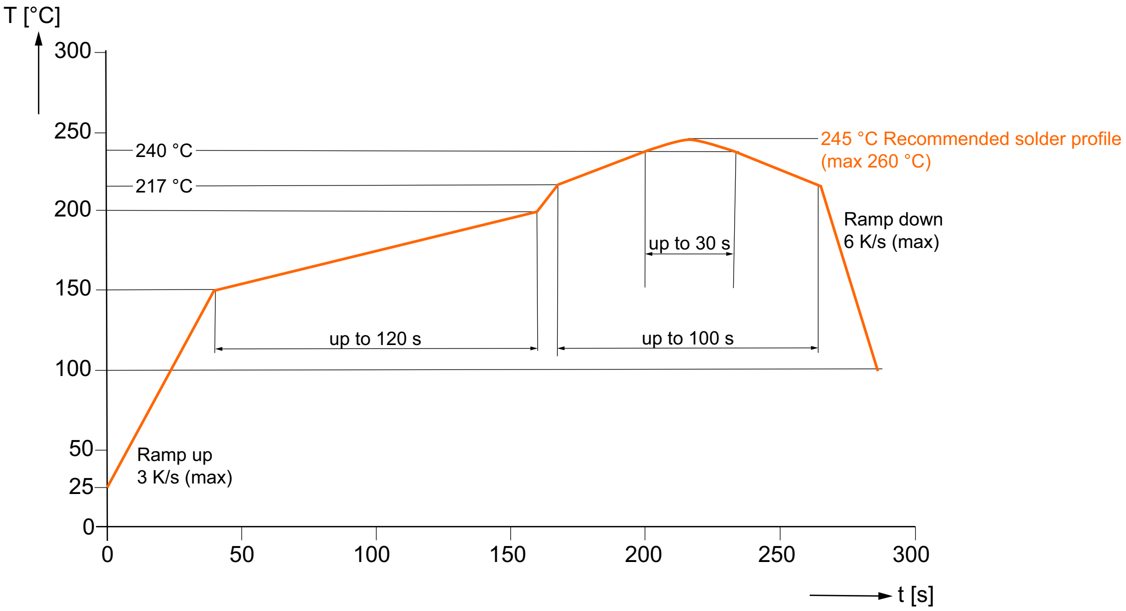


3.4 Reflow soldering

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 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. For superior solder joint connectivity results it is recommended to use a nitrogen atmosphere (<500ppm O_2).

Figure 8 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 8: Recommended temperature profile for lead-free reflow soldering in accordance with 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

3.5 Solder joint inspection

A visual inspection in combination with X-ray inspection ensures proper solder joint quality and helps to identify common solder joint issues or defects such as solder balls, solder bridges, high void level or placement position. In addition, a proper inspection ensures to determine correct design (PCB solder pad and stencil) or assembly process settings (printing parameter, pick-and-place position and settings). As a common industry standard, it is recommended to control the solder joint quality for every new product or design and therefor indicate design or manufacturing issues in an early stage.

The package design of the SFH 7018 is featured with integrated wettable side flanks or so-called solder control structures which enable an excellent self-alignment during reflow soldering. The solder wetting structure as shown in Figure 9 promote solder wetting for the formation of a solder fillet and minimize risk of rotation and tilting of the component. Uniform solder fillets are therefore beneficial to enable visual inspection and usage of automatic optical inspection systems (AOI).

Figure 9: Solder side wetting structure for solder joint inspection

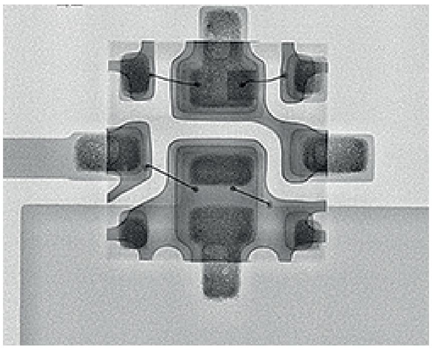
As an established practice during inhouse tests, X-ray inspection should be performed twice, before the reflow process and after. Before soldering, x-ray image gives an optimal indication of proper component placement. For example, if solder paste squeeze out can be seen, it is an indication for high placement force. Since the distances between the solder pads are relatively small, it is possible to see in early stages whether solder balls or solder bridges are formed.

X-ray inspection after reflow soldering is typically used to check void level but also confirm that there are no solder balls or solder bridges under the components. Figure 10 show examples of a x-ray solder joint inspection before and after the reflow process.

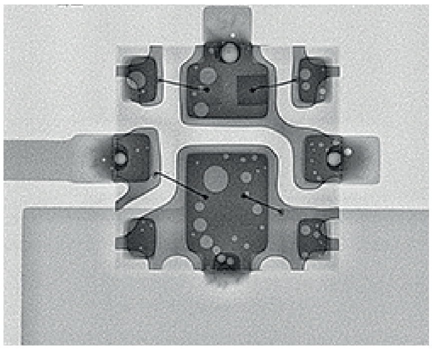
Figure 10: x-ray solder joint inspection

X-Ray inspection before reflow process

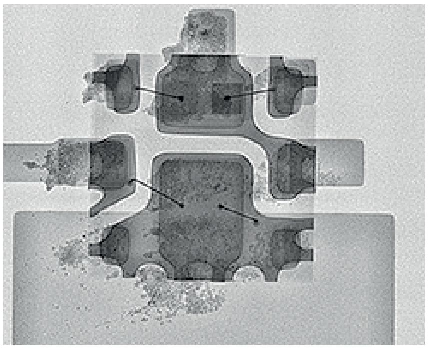
X-Ray inspection after reflow process



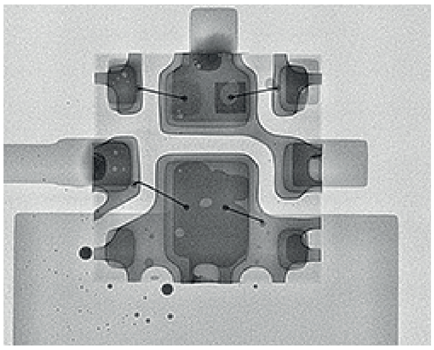
Proper component placement
No indication of possible soldering failures



Proper selfcentering
Acceptable voiding level



Idication of solder squeeze out, solder balls or bridges are possible



Bad solder level
Solder balls

4 Summary

The MULTILED® SFH 7018 has a separate anode for red, IR and green so that the emitters can be controlled separately and provide an efficient battery management. The SFH 7018 offers two cavities and a reflective package with reduced side emissions. 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.

The process recommendations described in this application note should be followed. Processing should be carried out with automatic placement machines using the recommended solder pads, solder stencils and pick-and-place nozzles. Due to the small solder structures, proper solder paste printing and inspection of the solder joints is essential for the final solder quality.

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