AN90002

Wave soldering guidelines for flatpack packages

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Document information

Info	Content
Keywords	Wave soldering, flatpack, SOD123F, CFP3, CFP5, CFP15, footprint design
Abstract	This application note provides wave soldering guidelines for Nexperia flatpacks, SOD123F, CFP3 (SOD123W), CFP5 (SOD128), and CFP15 (SOT1289). The content includes wave soldering footprint recommendations, wave soldering process and temperature profile.

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Revision history

Revision number	Date	Description
1.0	2017-11-30	Initial version of the document

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1 Introduction

This application note provides guidelines for board mounting by wave soldering of four flatpacks (package with flat leads): SOD123F, CFP3 (SOD123W), CFP5 (SOD128) and CFP15 (SOT1289).

Although reflow soldering is major technology for soldering of surface mount devices, wave soldering is also widely applied at many customers, especially for power supply applications.

This application note describes the recommendations for wave soldering of the Printed-Circuit Board (PCB) land pattern, including:

- the guidelines for component mounting
- the process requirements for wave soldering

While this application note helps minimizing any unexpected failures, following the advice in this document is not a guarantee for a perfect assembly result. The result may differ depending on the machine capability, ambient conditions, material, etc.

2 SOD123F, CFP3 (SOD123W), CFP5 (SOD128) and CFP15 (SOT1289): package details

SOD123F, CFP3 (SOD123W), CFP5 (SOD128) and CFP15 (SOT1289) are plastic, flat leads, Surface-Mounted Device (SMD) packages.

Key features:

- SOD123F, CFP3 (SOD123W) and CFP5 (SOD128): small and flat lead SMD plastic packages.
- CFP3 (SOD123W), CFP5 (SOD128) and CFP15(SOT1289) : high power capability due to clip bond technology.
- CFP15 (SOT1289): small and ultra-thin SMD plastic package with heat sink.

The visual appearance of SOD123F is shown in Figure 1 whereas Figure 2 shows the package dimensions.

The visual appearance of CFP3 (SOD123W) is shown in Figure 3 whereas Figure 4 shows the package dimensions.

The visual appearance of CFP5 (SOD128) is shown in Figure 5 whereas Figure 6 shows the package dimensions.

The visual appearance of CFP15 (SOD1289) is shown in Figure 7 whereas Figure 8 shows the package dimensions.

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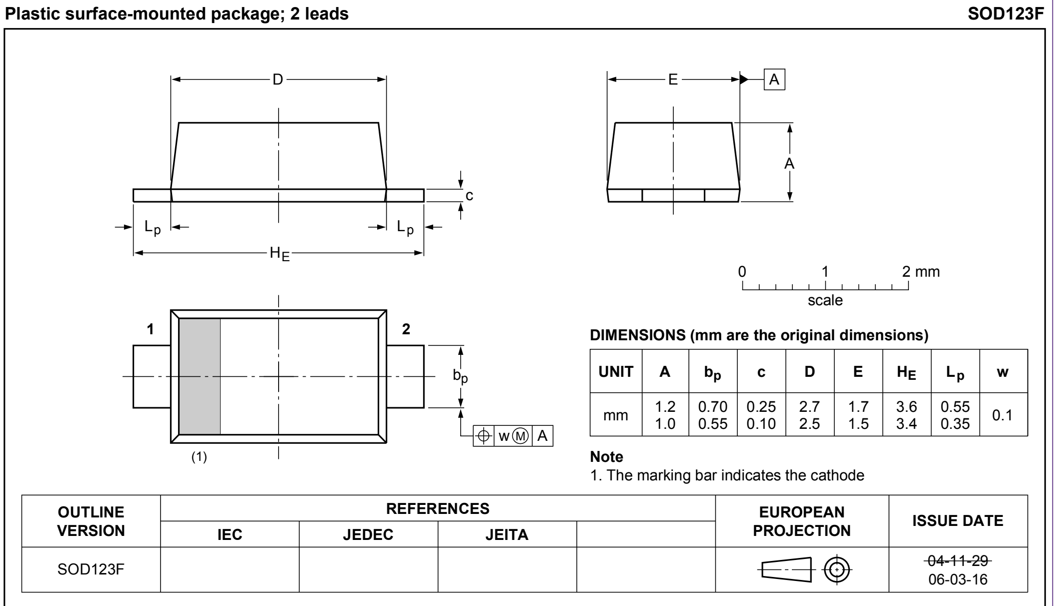
Figure 1. SOD123F: visual appearance



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_p	c	D	E	H_E	L_p	w
mm	1.2 1.0	0.70 0.55	0.25 0.10	2.7 2.5	1.7 1.5	3.6 3.4	0.55 0.35	0.1

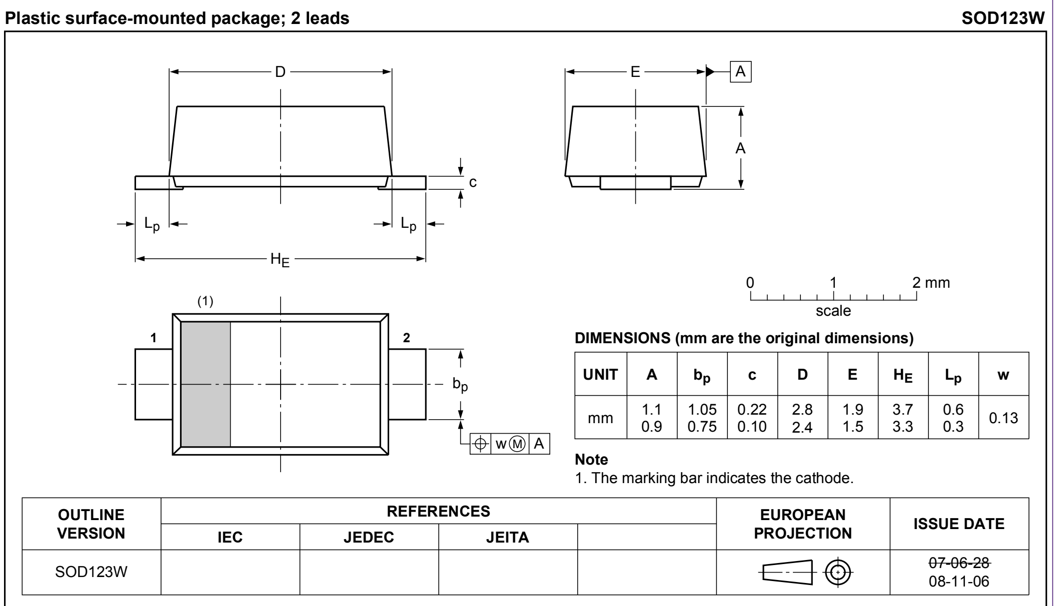
Note

1. The marking bar indicates the cathode

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOD123F						~~04-11-29~~ 06-03-16

Figure 2. SOD123F: package dimensions

Figure 3. CFP3 (SOD123W): visual appearance



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_p	c	D	E	H_E	L_p	w
mm	1.1 0.9	1.05 0.75	0.22 0.10	2.8 2.4	1.9 1.5	3.7 3.3	0.6 0.3	0.13

Note

1. The marking bar indicates the cathode.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOD123W						~~07-06-28~~ 08-11-06

Figure 4. CFP3 (SOD123W): package dimensions

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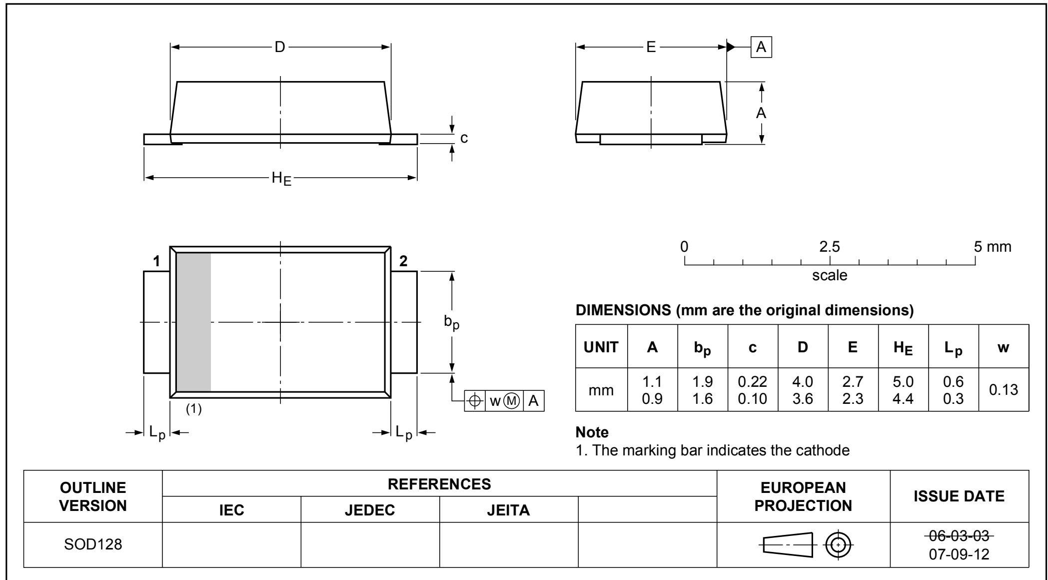
Figure 5. CFP5 (SOD128) visual appearance



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_p	c	D	E	H_E	L_p	w
mm	1.1 0.9	1.9 1.6	0.22 0.10	4.0 3.6	2.7 2.3	5.0 4.4	0.6 0.3	0.13

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOD128						~~06-03-03~~ 07-09-12

Figure 6. CFP5 (SOD128): package dimensions

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Figure 7. CFP15 (SOT1289): visual appearance

CFP15: plastic, thermal enhanced ultra thin SMD package; 3 leads; body: 5.8 x 4.3 x 0.78 mm **SOT1289**

0 2.5 5 mm
scale

Dimensions (mm are the original dimensions)

Unit		A	C	D	D_1	E	e	b	b_1	b_2	b_3	L	L_1	L_2
	max	0.82	0.24	6.6	5.9	4.4		4.8	4.2	1.3	0.45	3.5	2.15	1.3
mm	nom	0.78	0.20	6.5	5.8	4.3	2.13	4.6	4.0	1.1	0.35	3.3	2.05	1.2
	min	0.74	0.16	6.4	5.7	4.2		4.4	3.8	0.9	0.25	3.1	1.95	1.1

sot1289_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1289						~~14-07-23~~ 14-09-01

Figure 8. CFP15 (SOT1289): package dimensions

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3 PCB requirements and solder pattern

3.1 PCB material and surface finishing

The substrates used for mounting the packages can be made of a variety of materials with different properties such as FR4, FR5, Bismaleimide-Triazine resin (BT), flexible polymers (polyimides or polyamide), etc. There are no special constraint for wave soldering application, as long as the board can sustain wave-soldering temperature.

Common board finishes include NiAu, Organic Solderability Preservative (OSP), immersion Sn and Hot Air Surface Leveling (HASL). Although finishes may look different after soldering, and some appear to have better wetting characteristics than other, all common finishes can be used, provided that they are in accordance with the specifications (for example IPC-A-610).

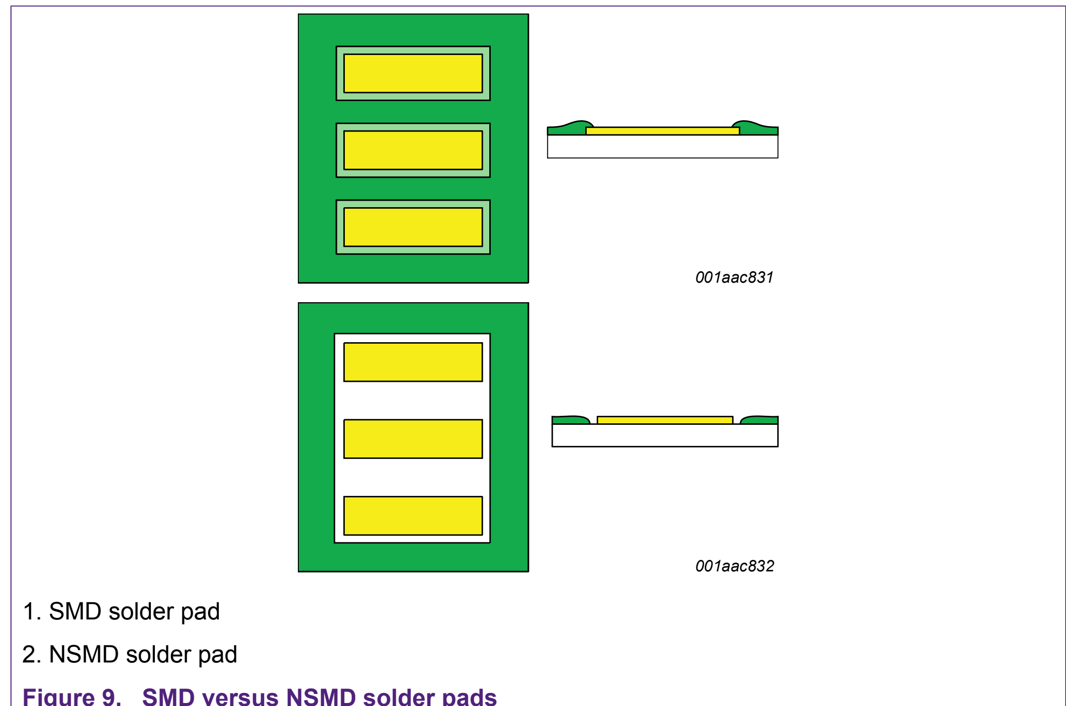
3.2 Solder mask (resist) design

There are two types of solder pad / solder resist designs:

Solder Mask Defined (SMD) and Non-Solder Mask Defined (NSMD).

SMD is a method of designing the solder resist to partially overlap the copper (CU) landing pattern on the PCB. NSMD designs have a gap between the solder resist and the Cu landing pattern on the PCB. These two types are described in more details on Figure 9.

For wave soldering, any of the solder mask configurations can be used without significant impact to soldering outcome. It is recommended to use NSMD in this document, because it is an easy PCB manufacturing method.



1. SMD solder pad
2. NSMD solder pad

Figure 9. SMD versus NSMD solder pads

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3.3 Solder land (footprint) design

A footprint design describes the recommended dimensions of the solder lands on the PCB, to make reliable solder joints between the semiconductor package and the PCB. In wave soldering, the solder pad dimensions should be larger than normal footprint dimensions for reflow soldering. This is to allow the molten solder from the wave to have enough contact area with Cu pad, and a path to flow through the pad underneath the package.

Reduce the glue volume to a minimum, as long as it can hold the package. To avoid excessive glue that may spread onto solder pads, place two small glue dots at side of the package. However, if glue volume is controlled to avoid that the glue spreads onto Cu pads, it is sufficient to apply one glue dot at the center of the device for SOD123F, CFP3 (SOD123W) and CFP5 (SOD128).

In addition, to give the glue some room under the plastic body of a package, dummy tracks on PCB can be designed under the plastic body. Etch away the Cu and make an opening in solder resist to generate a trench underneath the plastic body. A similar effect can be achieved with NSMD tracks. This is a known method to balance surface topography differences of the PCB by designing either normal or dummy tracks underneath a component.

Wave soldering footprint design for SOD123F, CFP3 (SOD123W), CFP5 (SOD128) and CFP15 (SOT1289), including glue dot, are shown in Figure 10, Figure 11, Figure 12 and Figure 13, respectively.

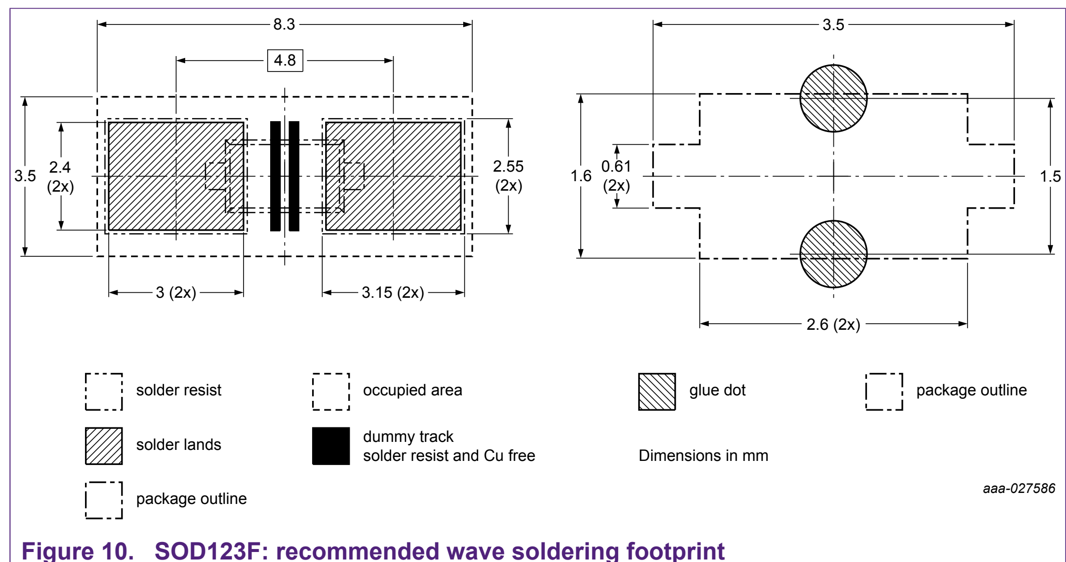

Figure 10. SOD123F: recommended wave soldering footprint

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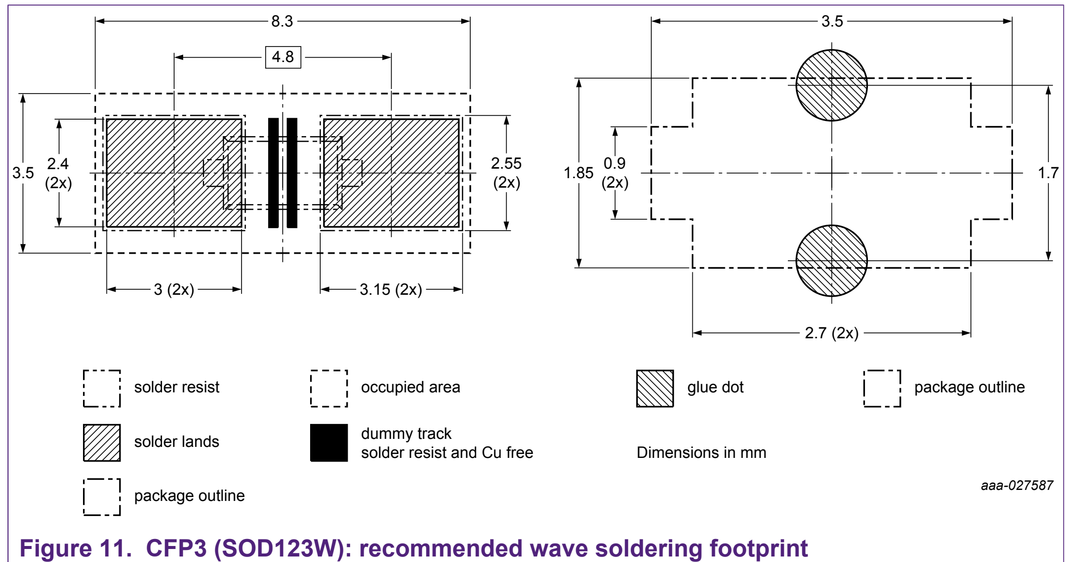

Figure 11. CFP3 (SOD123W): recommended wave soldering footprint

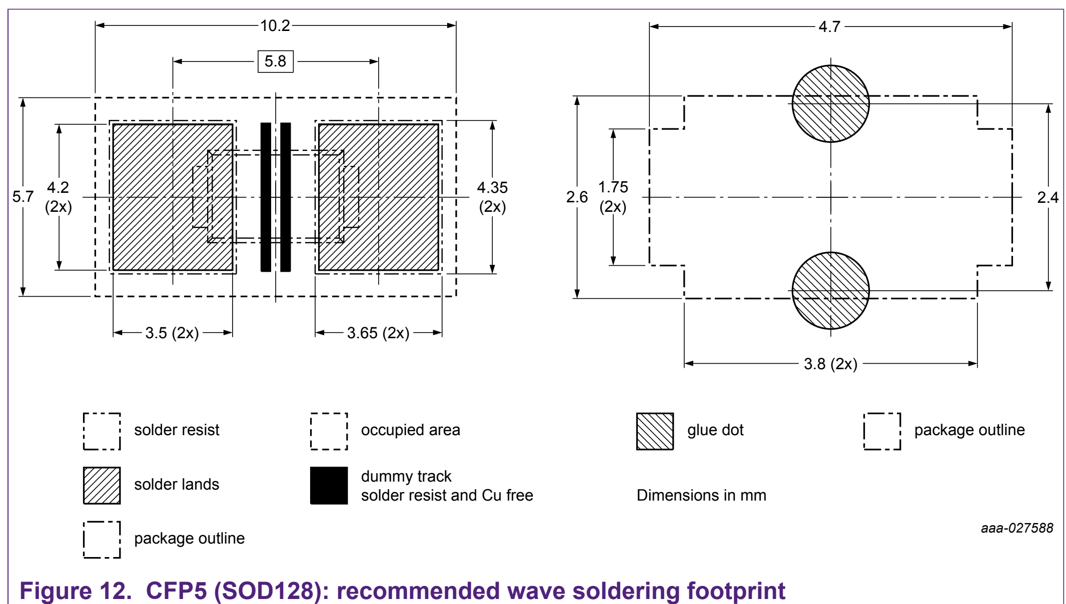

Figure 12. CFP5 (SOD128): recommended wave soldering footprint

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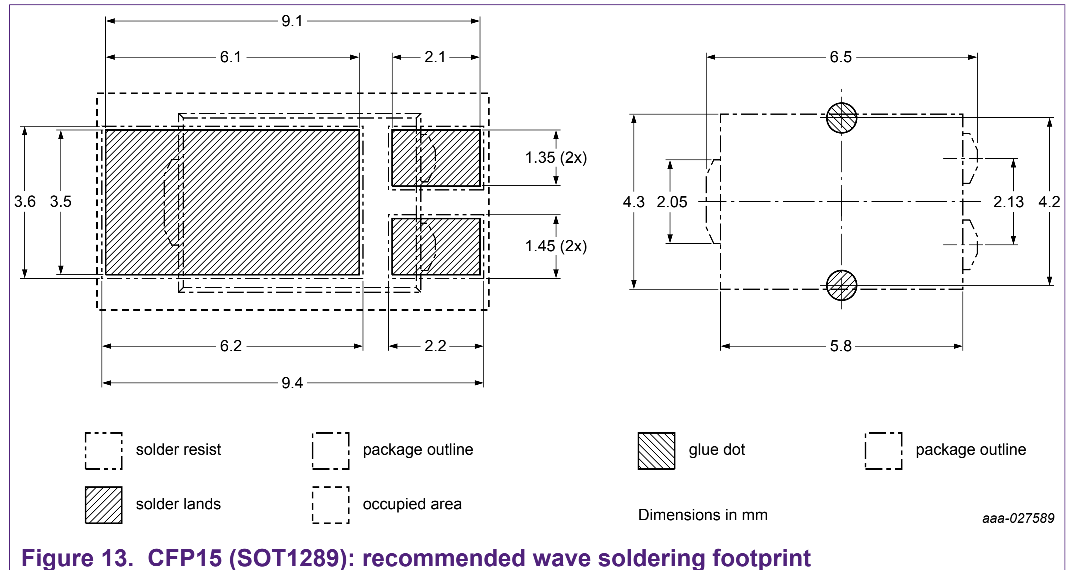

Figure 13. CFP15 (SOT1289): recommended wave soldering footprint

3.4 Component orientation

The component orientation on board refers to the direction of the component on the wave soldering machine conveyor. The orientation can be either:

- 0 °: The long axis of the component is parallel to the direction of board traveling along the wave soldering machine conveyor.
- 90 °: The long axis of the component is perpendicular to the direction of board traveling along the wave soldering machine conveyor.

According to the standard IPC-7351, an orientation of 90 ° is preferable for SOD123F, CFP3 (SOD123W), CFP5 (SOD128) and CFP15 (SOT1289). However, Nexperia investigations confirmed that both travel directions result in good solder connections.

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4 Wave soldering process

4.1 Adhesive

To hold components on the board during wave soldering, it is necessary to bond them to the PCB with adhesive dots. The glue must be tacky enough and have sufficent volume so that the component would not move or fall off during transport from peak and place machine to curing equipment. It also must have good adhesion strength after curing to prevent it from falling off during the whole wave soldering process.

4.1.1 Applying adhesive

For SOD123F, CFP3 (SOD123W), CFP5 (SOD128) and CFP15 (SOT1289), either printing or dispensing of adhesive is possible. in order to achieve better planarity and consistent volume, Nexperia wave soldering investigations used the method of printing with stencil thickness of 0.1 mm (4 mil).

4.1.2 Curing adhesive

Adhesive must be cured according to the specified conditions of the supplier. Glue should be fully cured before wave soldering.

4.2 Solder flux

Fluxing is necessary to promote wetting of both the PCB and the mounted components. Fluxing ensures good and even solder joints. After the fluxing process, the solder side of the PCB (including the components) is covered with a thin layer of flux. Flux can be applied onto PCB by spraying or foaming.

Use no-clean flux with low corrosive content like Rosin Mildly Activated (RMA) flux.

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4.3 Wave soldering

Recommended wave soldering profile is described in Figure 14 and Table 1.

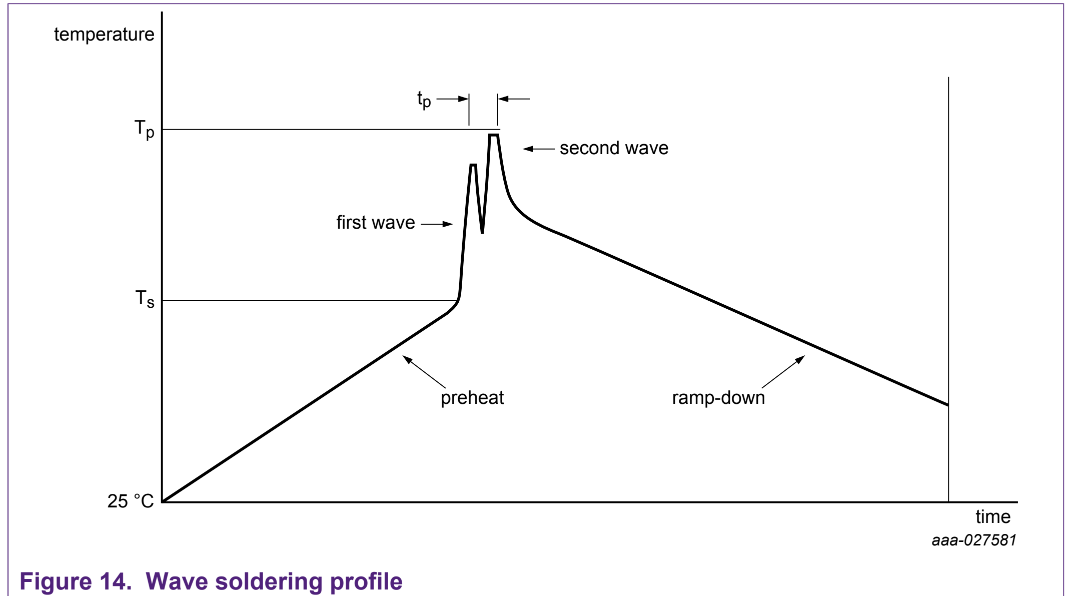

Figure 14. Wave soldering profile

Table 1. Wave soldering parameters

Profile Feature	SnBb eutectic assembly	Pb-free assembly
Average ramp-up rate	~ 200 °C/s	~ 200 °C/s
Heating rate during preheat	1°C/s to 2 °C/s typical, 4 °C/s maximum	1°C/s to 2 °C/s typical, 4 °C/s maximum
Final preheat temperature T_s	~ 130 °C	~ 130 °C
Peak temperature T_p	235 °C	260 °C
Maximum time within peak temperature t_p	10 s	10 s
Ramp-down rate	5 °C/s maximum	5 °C/s maximum

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5 Nexperia wave soldering trials

Nexperia performed wave soldering trials at third party institute for SOD123F, CFP3 (SOD123W), CFP5 (SOD128) and CFP15 (SOT1289). The trials were based on already mentioned designs, recommendations and guidelines . The results of the trials confirmed the recommendations given in this application note. The complete report is available on request.

The results from wave soldering trials are summarized in Table 2.

Table 2. Wave soldering trials

Performances	SOD123F	CFP3 (SOD123W)	CFP5 (SOD128)	CFP15 (SOT1289)
Adhesive printing	Good	Good	Good	Good
Component placement	Good	Good	Good	Good
Shear force - After adhesive curing	> 1500 g	> 1400 g	> 3200 g	Pass
Solder joint	Good	Good	Good	Good
Shear force - After wave soldering	> 5600 g	> 6700 g	> 10700 g	> 15000 g

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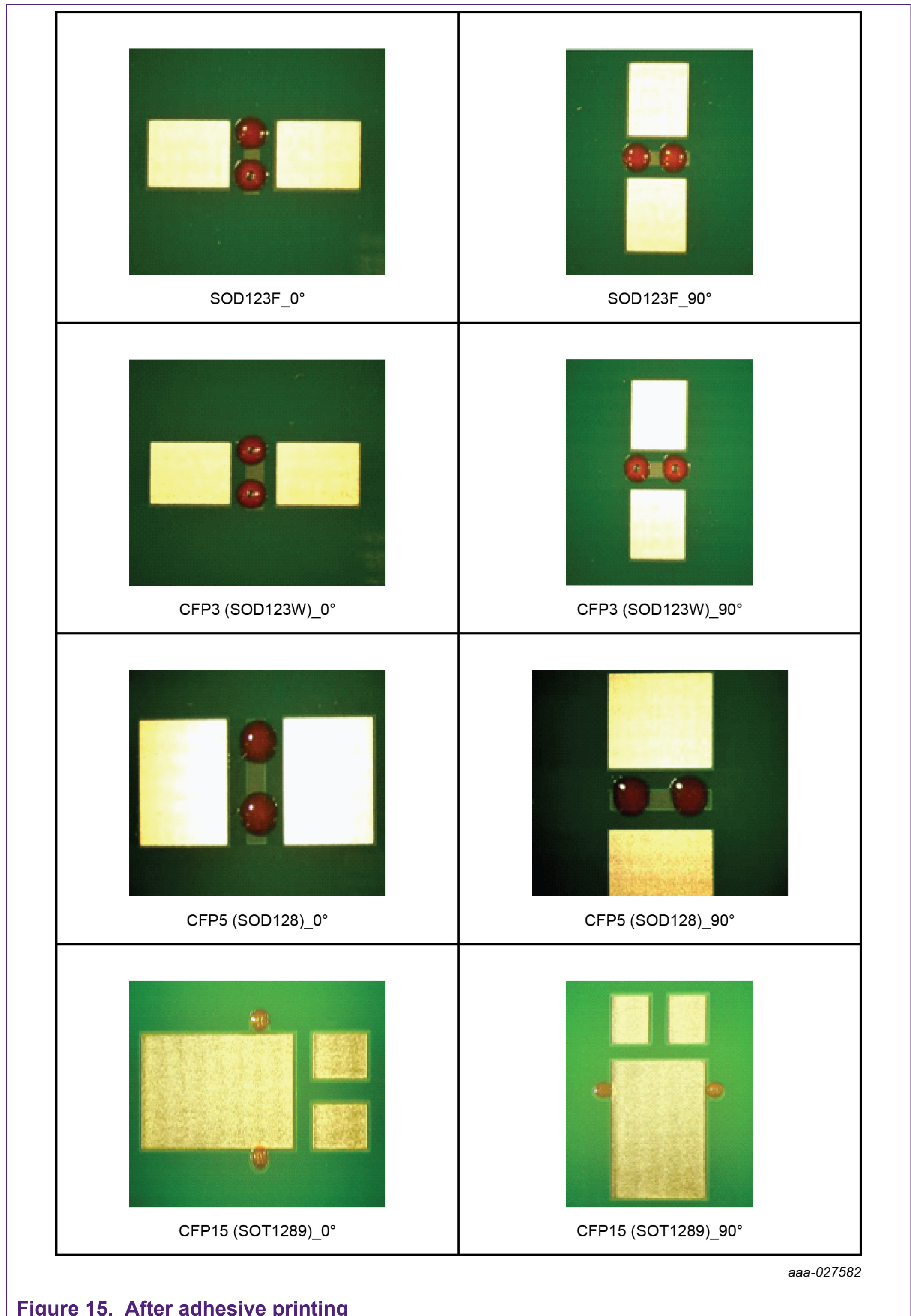

Figure 15. After adhesive printing

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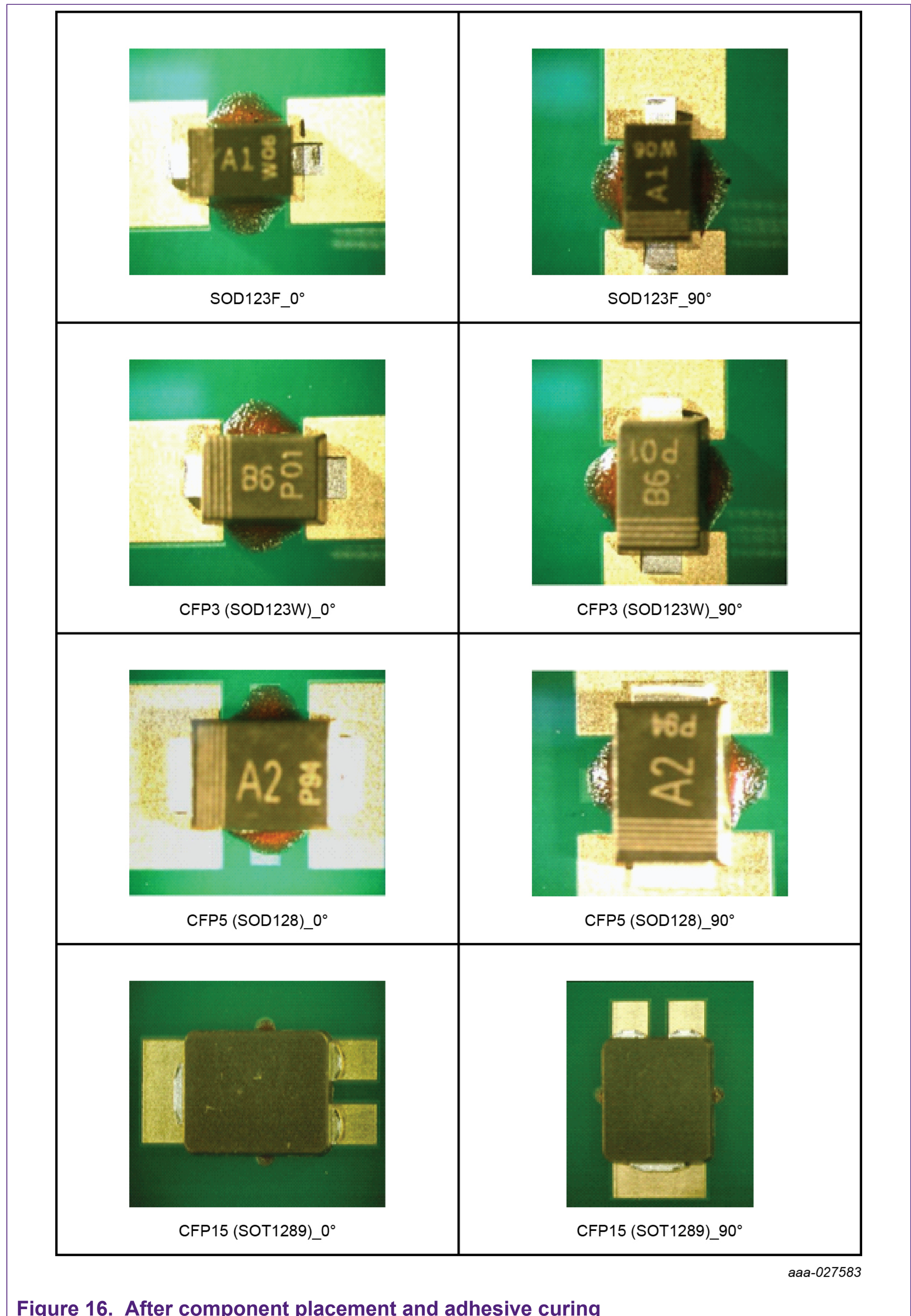

Figure 16. After component placement and adhesive curing

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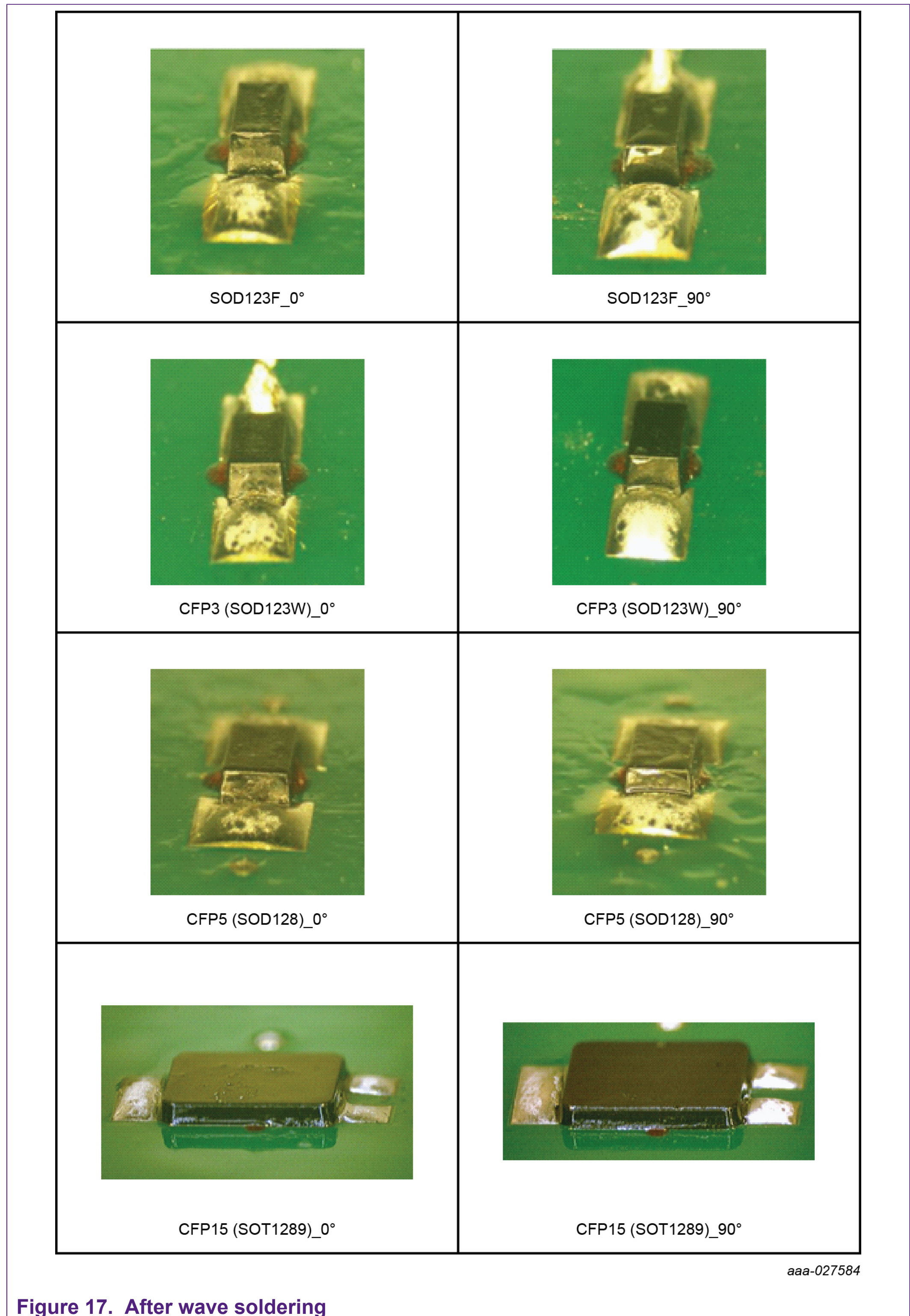

Figure 17. After wave soldering

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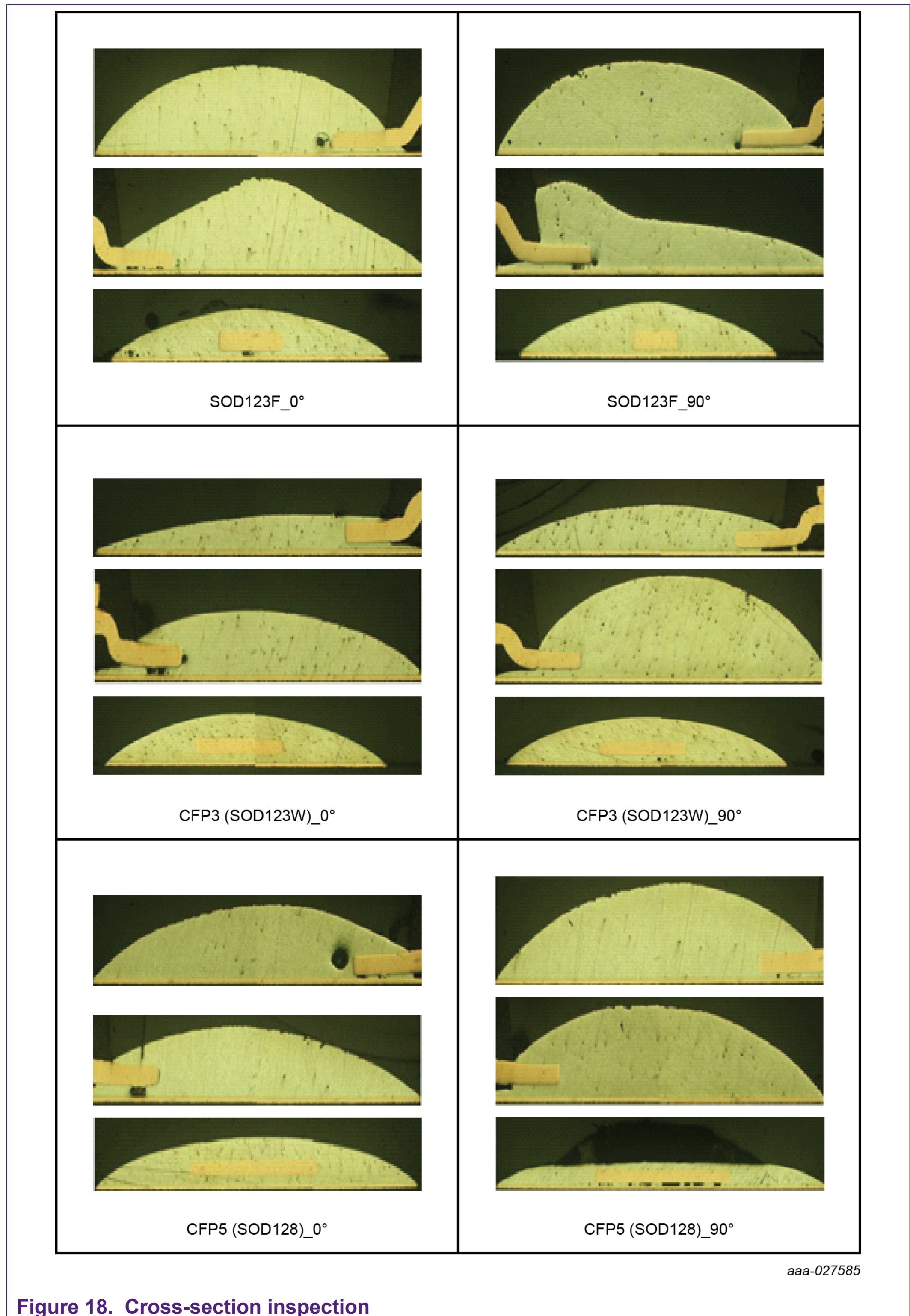

Figure 18. Cross-section inspection

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