Recommendations for Assembly of Infineon PG-DSOF-8-16 Package

Application Note

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Sense & Control

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Revision History 2011-09-21, Revision 2.1	
Page or Item	**Subjects (major changes since previous revision)**
Page 14	New chapter: Pick-and-Place

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1 Introduction

The PG-DSOF package family consists of 3 package types:

- PG-DSOF-8-12 with removable cap
- PG-DSOF-8-13 with heat sink and removable cap
- PG-DSOF-8-16 with fixed lid

This assembly note focuses on package type PG-DSOF-8-16.

This package type is used for following Infineon pressure sensor products:

- Sideairbag Sensors
- Barometric Air Pressure Sensors
- Manifold Air Pressure Sensors

The assembly note describes how to handle the PG-DSOF-8-16 package and gives recommendations for processing of PG-DSOF-8-16 SMD package with reflow soldering processes.

1.1 Surface Mount Devices

Surface Mount Devices (SMD) are soldered directly onto the surface of PCBs. This technology is called Surface Mount Technology (SMT)

1.2 Package Description

Infineons PG-DSOF-8-16 package is a leaded SMD package where the leads are bent inside the molding compound (Thermo set) with a lead surface finish of Ni/NiP/Pd/Au.

The PG-DSOF-8-16 package is supplied with a fixed lid, see **Figure 1**

Features:

- Green SMD package
- fulfills the conditions for lead-free board assembly
- optimized regarding mechanical stress influences

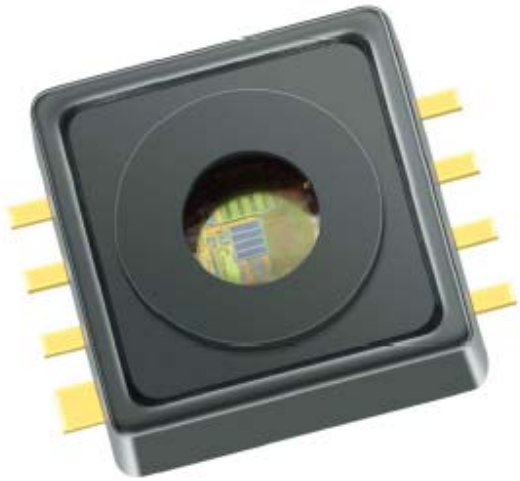

Figure 1 PG-PDSOF-8-16 with fixed lid

2 Package Handling

2.1 ESD Protective Measures

Semiconductor devices are normally Electrostatic Discharge Sensitive Devices (ESDS) requiring specific precautionary measures regarding handling and processing. Discharging of electrostatically charged objects over an IC, caused by human touch or processing tools may cause high current respectively high voltage pulses that can damage or even destroy sensitive semiconductor structures. On the other hand, ICs may also be charged during processing. If discharging takes place too quickly (hard discharge), it may cause load pulses and damages, too. ESD protective measures must therefore prevent contact with charged parts as well as charging of the ICs. Protective measures against ESD include handling, processing and packing of ESDS. A few hints are provided below on handling and processing.

2.1.1 ESD Protective Measures in the Workplace

- Standard marking of ESD protected areas
- Access control with tester for footwear and wrist strap
- Air conditioning
- Dissipative and grounded floor
- Dissipative and grounded working and storage areas
- Dissipative chairs
- Earth (“ground”) bonding points for wrist straps
- Trolleys or carts with dissipative surfaces and wheels
- Suitable shipping and storage containers
- No sources of electrostatic fields

2.1.2 Equipment for personal

- Dissipative/conductive footwear or heal grounder
- Garments
- Wrist straps
- Gloves or finger coats which are ESD-proven
- Regular training of staff

2.1.3 Production Installation and Processing Tools

- Machine and toolparts made of dissipative or metallic materials
- No materials having thin insulating layers for sliding tracks
- All parts reliable connected to ground potential
- No potential difference between individual machine and tool parts
- No sources of electrostatic fields

Detailed information on ESD protective measures may be obtained from the ESD specialist through Area Sales Offices. Our recommendations are based on the internally applicable standards IEC61340-5-1 and ANSI/ESD S2020.

2.2 Packing of components

List of relevant standards which should be considered

Infineon packs according to the IEC 60286-* series (IEC 60286-3 is similar to the EIA 481-*).

IEC 60286-3	Packaging of components for automatic handling - Part 3: Packaging of surface mount components on continuous tapes
IEC 60286-4	Packaging of components for automatic handling - Part 4: Stick magazines for dual-in-line packages
IEC 60286-5	Packaging of components for automatic handling - Part 5: Matrix trays

Moisture sensitive Surface Mount Devices are packed according to IPC/JEDEC J-STD-033*:

Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices

Other references:

ANSI/EIA-481-*	EIA Standard 8 mm through 200 mm embossed Carrier Taping and 8 mm & 12 mm Punched Carrier Taping of Surface Mount Components for Automatic Handling

PDSOF packages are supplied in tapes on reel for feeding in an automatic pick&place machine.

Detailed packing drawings: More information are available on **www.infineon.com/package**

2.3 Moisture Sensitive Components (MSL classification)

For moisture sensitive packages, it is necessary to control the moisture content of the components. Penetration of moisture into the package molding compound is generally caused by expose to ambient air. In many cases, moisture absorption leads to moisture concentrations in the component that are high enough to damage the package during the reflow process. Thus it is necessary to dry moisture sensitive components, seal them in a moisture-resistant bag, and only remove them immediately prior to board assembly. The permissible time (from opening the moisture barrier bag until the final soldering process), which a component can remain outside the moisture barrier bag, is a measure of the sensitivity of the component to ambient humidity (MSL). The most commonly applied standard IPC/JEDEC J-STD-020C defines eight different MSLs, see **Table 1**.

The Moisture Sensitivity Level for PG-DSOF-8-16 is MSL1.

Table 1 Moisture Sensitivity Level

Level	Floor Life		Soak requirements	
	Time	**Conditions**	**Time**	**Conditions**
1	Unlimited	30°C / 85% RH	168 hours	85°C / 85% RH
2	1 year	30°C / 60% RH	168 hours	85°C / 60% RH
2a	4 weeks	30°C / 60% RH	696 hours	30°C / 60% RH
3	168 hours	30°C / 60% RH	193 hours	30°C / 60% RH
4	72 hours	30°C / 60% RH	96 hours	30°C / 60% RH
5	48 hours	30°C / 60% RH	72 hours	30°C / 60% RH
5a	24 hours	30°C / 60% RH	48 hours	30°C / 60% RH
6	Time On Label (TOL)	30°C / 60% RH	TOL	30°C / 60% RH

If moisture sensitive components have been exposed to ambient air for longer than the specified time according to their MSL, or the humidity indicator card indicates to much moisture after opening a Moisture Barrier Bag (MBB), the components have to be baked prior to the assembly process. Please refer to IPC/JEDEC J-STD-020C for details **[1]**. Baking a package to often can cause solderability problems due to oxidation and/or intermetallic growth. In addition, packing materials (tape and reel) may not withstand higher baking temperatures.

2.4 Storage and Transportation Conditions

Improper transportation and unsuitable storage of components can lead to a number of problems during subsequent processing, such as poor solderability, delamination, and package cracks effects.

List of relevant standards which should be considered

IEC 60721-3-0	Classification of environmental conditions: Part3: Classification of groups of environmental parameters and their severities; Introduction
IEC 60721-3-1	Classification of environmental conditions: Part3: Classification of groups of environmental parameters and their severities; Storage
IEC 60721-3-2	Classification of environmental conditions: Part3: Classification of groups of environmental parameters and their severities; Transportation
IEC 61760-2	Surface mounting technology - Part 2: Transportation and Storage conditions of surface mounting devices (SMD) - Application Guide
IEC 62258-3	Semiconductor Die Products - Part 3: Recommendations for good practice in handling, packing and storage
ISO 14644-1	Clean rooms and associated controlled environments Part 1: Classification of airborne particulates

Table 2 General Storage Conditions - Overview

Product	Condition for Storing
Wafer/Die	N2 or MBB[1)] (IEC 62258-3)
Component - moisture sensitive	MBB (JEDEC J-STD-033*)
Component - not moisture sensitive	1K2 (IEC 60721-3-1)

1) MBB = Moisture Barrier Bag

Maximum Storage Time

The conditions to be complied with in order to ensure problem-free processing of active and passive components are described in standard IEC 61760-2.

Internet links to Standards Institutes

American National Standards Institute (ANSI)

Electronics Industries Alliance (EIA)

Association Connecting Electronics Industries (IPC)

2.5 Handling Damage and Contamination

Automatic or manual handling of components in or out of the component packing may cause mechanical damage to package leads and/or body

Generally the components in the packing are ready to use. The PG-DSOF-8-16 package is supplied with a fixed plastic lid. The flat surface of this lid on top of the package allows handling with standard pick and place tools.

Care should be taken during handling to avoid damage to the gel and lid:

- the gel can be damaged due to access through the hole in the lid
- the lid can be damaged through bending with push/pull forces. Lid bending with pull forces >1N and push forces >5N should be avoided.

Any contamination applied to the component or packing may cause or induce processes that may lead to device damage. The most critical issues are:

- Solderability problems
- Corrosion
- Electrical shorts (due to conductive particles)

2.6 Component Solderability

The sufficiently thick and wettable metal surfaces (final plating) of the device pins ensure good solderability, even after a long storage time.

Note that the cut edges of the pins should be ignored in any assessment of the solderability.

Suitable methods for the assessment of solderability can be derived from JESD22B 102 or IEC60068-2-58.

3 Assembly

The PG-DSOF-8-16 package is qualified for Pb-free reflow soldering process.

3.1 Process flow for reflow soldering

Typical flow for mounting SMDs with reflow soldering process:

- Application of solder paste to the PCB
- Solder paste inspection
- Placement of component on PCB
- Inspection
- Reflow soldering
- Inspection

3.2 Solder Paste

Solder paste consists of solder alloy and a flux system. Normally the volume is split into about 50% alloy and 50% flux and solvents. In term of mass, this means approximately 90 wt% alloy and 10 wt% flux system and solvents. The flux system has to remove oxides and contaminants from the solder joints during soldering process. The capability of removing oxides and contaminants depends on the activation level of the used flux.

The contained solvent adjusts the viscosity needed for the solder paste application process. The solvent has to evaporate during reflow process.

3.3 Pick-and-Place

3.3.1 Component Placement

Although the self-alignment effect due to the surface tension of the liquid solder will support the formation of reliable solder joints, the components have to be placed accurately according to the geometry. Positioning the package manually is not recommended. For PG-DSOF-8-16 an automatic pick-and-place machine is recommended to achieve reliable solder joints.

For PG-DSOF-8-16 package with a pad width of 0.4 mm (respectively 0.8 mm) and a pitch of 1.27 mm, an automatic pick-and-place machine is recommended to achieve reliable solder joints.

Component placement accuracies of ±50 µm are obtained with modern automatic component placement machines using vision systems. With these systems, both the PCB and the components are optically measured and the components are placed on the PCB at their programmed positions. The fiducials on the PCB are located either on the edge of the PCB for the entire PCB or additionally on individual mounting positions (local fiducials). They are detected by a vision system. Recognition of the packages immediately before the mounting process is performed by a special vision system, enabling the complete package to be correctly centered.

The PG-DSOF-8-16 device is delivered in tape and reel packing which is suitable for being used in pick-and-place equipment.

3.3.2 Nozzle

A pick-up nozzle suitable for the package body size should be used. Regarding the PG-DSOF package it is recommended that the used nozzle seals on the package rim. If a smaller nozzle is used this may lead to increased force in the package center, nozzle shape and size are more critical in this case.

For Pick and Place should be considered:

- a dynamic vacuum pressure puls of min. 10 kPa can be applied.
- the nozzle should be sealed on the package rim.
- if the nozzle is sealed on the lid, push/pull forces >5N should be avoided.

Recommendation for nozzle, sealed on the package rim:

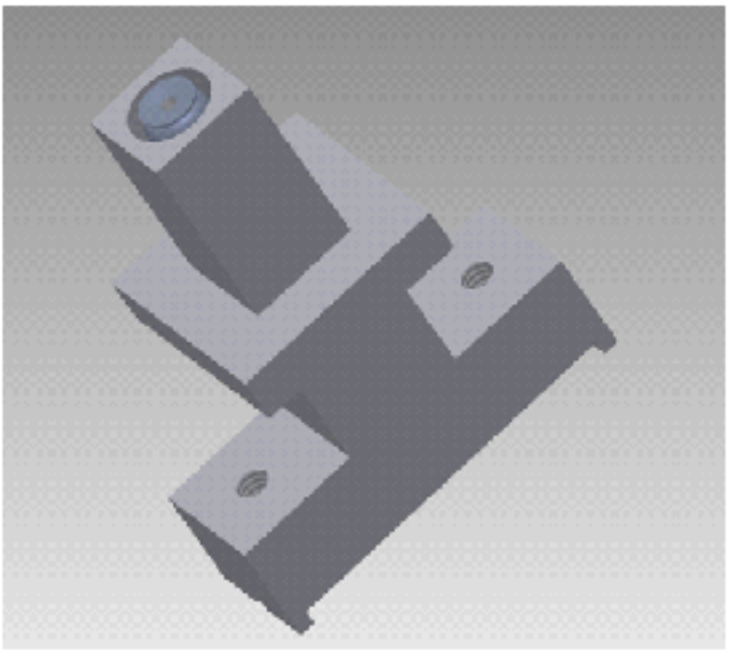

Figure 2 Recommended pick-up nozzle for PG-DSOF package

3.4 Reflow Soldering

Reflow soldering is the most common technique to attach SMD components to a circuit board. The goal of the reflow process is to melt the powder particles in the solder paste, thereby joining the appropriate surfaces, to create a strong metallurgical bond after solidification of the solder.

During the reflow process, each solder joint has to be exposed to temperatures above the melting point of solder for a sufficient time to get optimum solder joint quality, whereas overheating the PCB has to be avoided.

It is important that the maximum temperature of the package during reflow does not exceed the specified peak temperature of the moisture level.

When using infrared (IR) ovens without convection, special care may be necessary to assure a sufficiently homogeneous temperature profile for all solder joints on the PCB, especially on large, complex boards with different thermal masses of the components. Using infrared soldering, the components are heated as a result of absorbing IR radiation. Usually the heating is done with radiators positioned on either side in order to heat or preheat the whole area surrounding of the solder joint, if possible. The temperature of the different components may vary severely. Since the metallic terminals of the components exhibit only low absorption (because they

reflect IR radiation), the heat has to be applied to the solder joints via the component itself, the heated PCB and the ambient air.

Other ovens are based on heat transfer by infrared or vapor-phase.

Most reflow ovens use forced convection blowing hot air at different temperatures in different zones.

3.4.1 Forced Convection Reflow Process

The recommended reflow process is forced convection where the heat is transferred to the PCB in different zones by heated air or nitrogen. The number of zones, volume of hot gas and oven design determine the capacity and the ability to reproduce the optimum reflow profile, which is also influenced by:

- Board thickness and layout
- Differences in thermal mass of all components
- Maximum allowed component temperatures

A nitrogen atmosphere can generally improve solder joint quality, but is normally not necessary for soldering the available package lead finishes. For the lead-free process with higher reflow temperatures, a nitrogen atmosphere may reduce oxidation and improve solder joint quality.

3.4.2 Reflow Peak Temperature

Small volume SMD packages reach higher body temperature during reflow soldering to boards that have been profiled for larger packages. Therefore, technical and/or business issues normally require thin, small volume SMD packages to be classified at higher reflow temperatures, see IPC/JEDEC J-STD-020C. **Table 3** shows the peak reflow temperature for Pb-free soldering process related to the package thickness.

For PG-DSOF-8-16 package with a package thickness >2.5 mm and package volume <350mm^3, a reflow peak temperature of 250°C is recommended.

Table 3 Package Classfication Reflow Temperature

Package Thickness	Volume	Reflow Peak Temperature
<1.6 mm	<350 mm^3	260°C
1.6 mm - 2.5 mm	<350 mm^3	260°C
>2.5 mm	<350 mm^3	250°C

3.4.3 Reflow Profile Classification

The temperature profile of the reflow process is divided into several phases, each with a special function. In a conventional reflow process there are four different temperature zones: preheat, thermal soak, reflow and cooling. The PCBs are moved through these zones via conveyer belt.

The heated air increases board and component temperature, then activates the flux, and reflows the solder “printed” on the board surface, onto which components have been attached. After melting in the highest temperature zone, the solder wets all termination areas and, after cooling, makes the solder joint.

The single parameters are influenced by various factors, for example, the solder paste manufacturer’s application notes. Additionally most PCBs contain more than one package type and therefore the reflow profile has to be matched to all demands of the components and materials. It is recommended to measure the solder joint temperature by thermocouples beneath the package, taking into account that components with large thermal masses do not heat up as fast as lightweight components. The position and the surrounding of the package on the PCB, as well as the PCB thickness, can influence the solder joint temperature significantly

3.4.4 PG-DSOF-8-16 Reflow Profile

Figure 3 shows the reflow profile classification acc. to IPC/JEDEC J-STD-020C for Pb-free assembly of SMD packages.

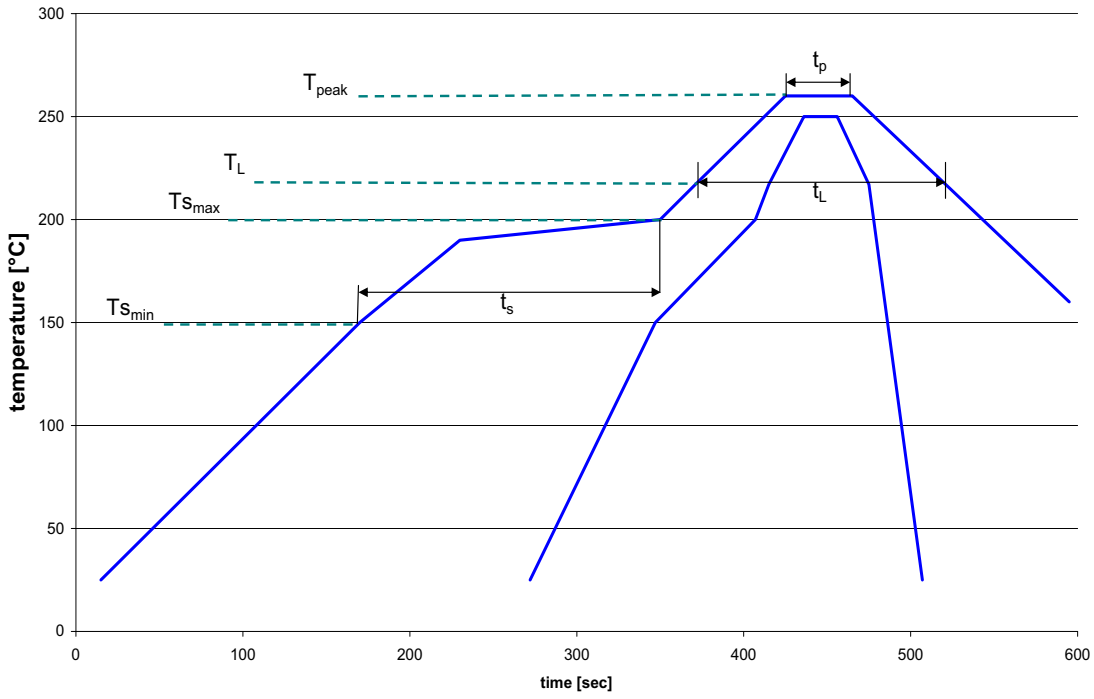

Figure 3 Classification Reflow Profile

The PG-DSOF-8-16 package can be soldered using standard reflow processes and temperature profiles as per IPC/JEDEC J-STD-020C, see **Figure 3**

Figure 4 shows the recommended reflow profile and **Table 4** the recommended reflow parameters for PG-DSOF-8-16 with lid.

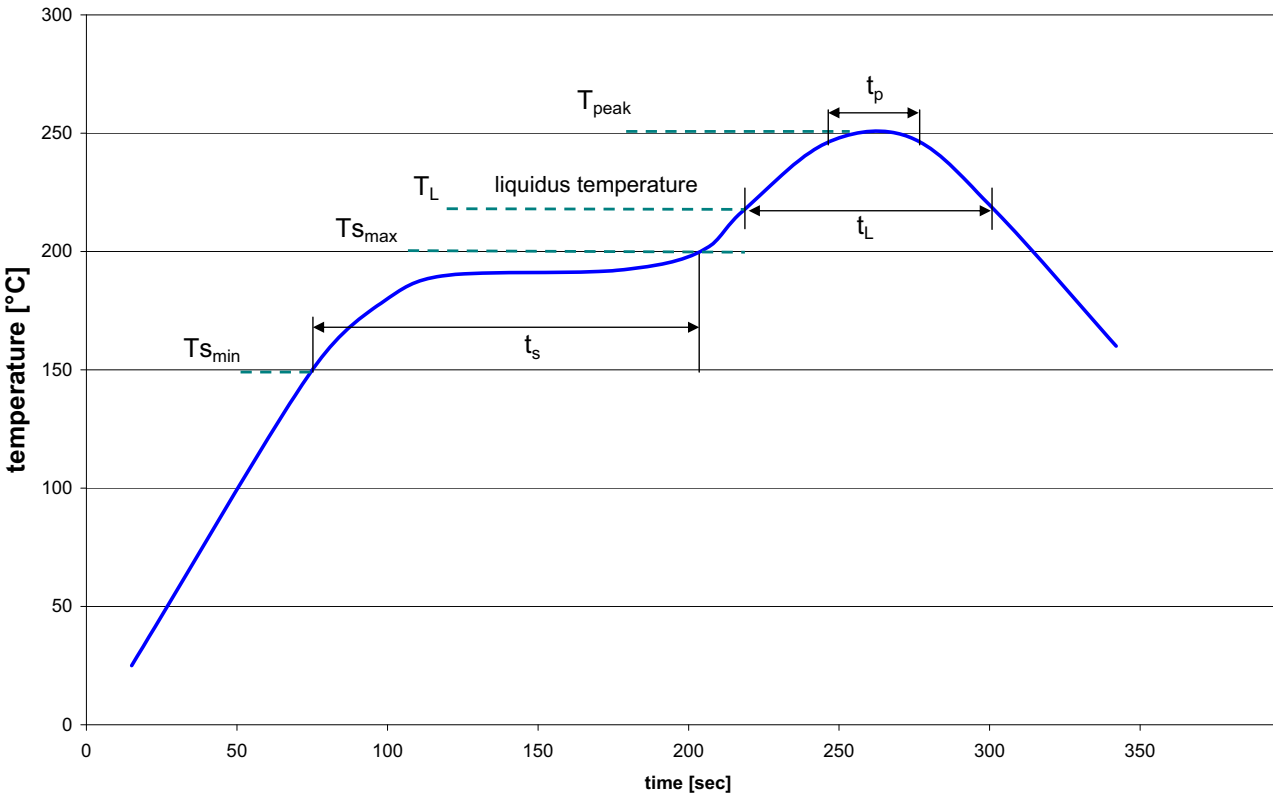

Figure 4 Recommended reflow temperature profile for PG-DSOF-8-16

Table 4 Reflow Profile Parameters

Profile Feature	Value
$T_{S\ min}$	150°C
$T_{S\ max}$	200°C
T_{peak}	250°C
T_L	217°C
Average Ramp-up Rate ($T_{S\ max}$ to T_{peak})	3°C/sec max
Time t_s (temperature from $T_{S\ min}$ to $T_{S\ max}$)	60-180 sec min.
Time t_L (temperature maintained above T_L)	60 - 150 sec
Time t_p (temperature maintained above T_{peak} - 5°C)	20 - 40 sec
Ramp down rate	6°C/sec max.
Time 25°C to T_{peak}	8 minutes max.

3.5 Cleaning

After the soldering process, flux residues can be found around the solder joints. If a “no-clean” solder paste has been used for printing, the flux residues usually do not have to be removed after the soldering process. However, if the solder joints should be cleaned, the cleaning methods have to be selected by considering the package requirements and environmental and safety aspects.

The PG-DSOF-8-16 package is compatible to standard PCB cleaning agents, for example VIGON™ A200 from Zestron (**www.zestron.com**).

During the cleaning process, it should be ensured that there is no contamination inside the lid hole and no mechanical damage to the gel (e.g. by applying a high pressure spray).

References

[1] IPC/JEDEC J-STD-020C (Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices)

[2] JESD22-B102 (Test Method for Solderability)

[3] IEC 60068-2-58 (Test Methods for Solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices)

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