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MOISTURE/REFLOW SENSITIVITY CLASSIFICATION FOR NON-HERMETIC SURFACE MOUNT DEVICES (SMDS)

Contents

Contents (cont'd)

LONG-TERM STORAGE GUIDELINES FOR ELECTRONIC SOLID-STATE WAFERS, DICE, AND DEVICES

(From JEDEC Board Ballot JCB-22-52, formulated under the cognizance of the JC-14.1 Committee on Reliability Test Methods for Packaged Devices.)

1 Purpose

The purpose of this standard is to identify the classification level of non-hermetic SMDs designed for surface mount assembly that are sensitive to moisture-induced stress so that they can be properly packaged, stored, and handled to avoid damage during assembly solder reflow attachment and/or repair operations.

This standard may be used to determine what classification level should be used for non-hermetic SMD qualification. Passing the criteria in this test method is not sufficient by itself to provide assurance of long-term reliability. The Moisture Sensitivity Levels (MSLs) rating generated for an SMD by this document is utilized to determine the soak conditions for preconditioning as per JESD22-A113 and how the SMD can be properly packaged, stored, and handled to avoid damage during assembly solder reflow attachment and/or repair operations as per J-STD-033.

For IC devices that may be process sensitive, please refer to J-STD-075 to determine if a PSL (Process Sensitivity Level) classification is required.

2 Scope

This classification procedure applies to all non-hermetic SMDs, which, because of absorbed moisture, could be sensitive to damage during solder reflow. The term SMD as used in this document means plastic encapsulated devices and other devices made with moisture-permeable materials designed for surface mount assemblies. The MSL classification levels are intended to be used by SMD producers to inform users (board assembly operations) of the level of moisture sensitivity of their SMDs~~,~~ and by board assembly operations to ensure that proper handling precautions are applied to moisture/reflow sensitive devices. If no major changes have been made to a previously qualified SMD, this method may be used for reclassification according to 4.3.

This standard cannot address all possible device, board assembly and product design combinations. However, the standard does provide a test method and criteria for commonly used technologies. Where uncommon or specialized devices or technologies are necessary, the development of the MSL rating should include customer and device supplier involvement and the criteria should include an agreed definition of product acceptance.

SMDs classified to a given moisture sensitivity level by using procedures or criteria defined within any previous version of J-STD-020 do not need to be reclassified to the current revision unless a change in classification level or a higher peak classification temperature is desired.

If the procedures in this document are used on packaged devices that are not included in this specification's scope, the failure criteria for such packages must be agreed upon by the device supplier and their end user.

2 Scope (cont'd)

Past evaluations have shown that SMDs that have been classified to a MSL for SnPb eutectic temperatures per this document may be attached using the same MSL for a Vapor Phase reflow process for SnPb eutectic temperatures only. Currently there is no intent to perform similar evaluations for Pb-free temperatures.

3 Background

The vapor pressure of moisture inside a non-hermetic package increases greatly when the package is exposed to the high temperature of solder reflow. Under certain conditions, this pressure can cause internal delamination of the packaging materials from the die and/or leadframe/laminate, internal cracks that may or may not extend to the outside of the package, bond damage, wire necking, bond lifting, die lifting, thin film cracking, or cratering beneath the bonds. In the most severe case, the stress can result in external package cracks. This is commonly referred to as the "popcorn" phenomenon because the internal stress causes the package to bulge and then delaminate/crack with an audible "pop." SMDs are more susceptible to this problem than through-hole parts because they are exposed to higher temperatures during reflow soldering. The reason for this is that the soldering operation must occur on the same side of the board as the SMD. For through-hole devices, the soldering operation occurs under the board that shields the devices from the hot solder.

4 Terms and Definitions

Other than the following, the definitions of terms used in this standard are in accordance with IPC-T-50. Terms marked with an asterisk (*) are direct excerpts of IPC-T-50 and are reprinted here for convenience.

Accelerated Equivalent Soak A soak at a higher temperature for a shorter time (compared to the standard soak), to provide roughly the same amount of moisture absorption. See also "Soak."

***Acoustic Microscope** Equipment that creates an image using ultrasound to view a specimen's surface or subsurface features, including defects and damage. See J-STD-035 for more information.

***Area Array Package** A package that has terminations arranged in a grid on the bottom of the package and contained within the package outline.

***Classification Temperature (Tc)** The maximum body temperature at which the device supplier guarantees the device MSL as noted on the caution and/or bar code label (per J-STD-033).

Crack A separation within a bulk material. See also "Delamination."

***Damage Response** All irreversible changes caused by exposure to a reflow soldering profile.

Dead-Bug (Orientation) The orientation of the package with the terminals facing up.

Delamination An interfacial separation between two materials intended to be bonded. See also "Crack".

Downbond Area An area for a wire bond on the die paddle, whose dimensions equal those of a single bond pad on the die.