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Storage and Handling of Drypacked Surface Mounted Devices (SMD)

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INTRODUCTION

This information provides Motorola customers with the necessary storage and handling guidelines to preclude component package cracking during solder reflow procedures.

This document applies to plastic encapsulated SMDs that Motorola identifies as moisture sensitive and delivers in a drypack. Moisture sensitive SMDs include, but are not limited to small outline J pins (SOJs), plastic leaded chip carriers (PLCCs), quad flat packs (QFPs), plastic quad flat packs (PQFPs), thin quad flat packs (TQFPs), thin small outline packages (TSOPs), small outline integrated circuits (SOICs), and plastic ball grid arrays (PBGAs).

SMD PACKAGE LIMITATIONS

During reflow procedures, moisture absorbed from the atmosphere will vaporize inside an SMD and swell into a vapor dome. The internal stresses exerted by the vapor dome are directly proportional to the amount of moisture absorbed prior to reflow. The pressure from the vapor dome may cause of one or more of the internal package interfaces to delaminate. This pressure may also form cracks in the mold compound and possibly expose the die to the external environment.

Both, die surface delaminating and package cracks, pose potential reliability problems. By following the guidelines herein, Motorola customers will avoid the occurrence of these problems.

DRYPACK DESCRIPTION

Drypack consists of a moisture vapor barrier bag with a preprinted moisture sensitive warning label, a desiccant, and RH indicator, and a barcode label.

The bag construction consists of a three layer laminate; tyvek or nylon for puncture resistance, aluminum for a moisture barrier, and polyethylene for an airtight seal.

The preprinted warning label identifies the contents as moisture sensitive and outlines the recommended storage and handling requirements and shelf life.

The desiccant packed in each bag will keep the internal humidity level below 20% RH for at least one year, under worst case storage conditions of 40°C and 90% RH.

The RH indicator provides the customer with a simple and efficient means to verify that the internal humidity level remains below 20% RH during storage. NOTE: If the RH indicator reads greater than 20% RH at 23°C ± 5°C immediately upon opening the bag, then the SMDs contained therein must undergo a dry–out procedure (see Dry–Out Procedures) prior to any reflow process.

The barcode label identifies the bag seal date and the qualified moisture sensitivity level of the SMD. Motorola specification 12MRE20040W, Moisture Characterization and Preconditioning of Plastic Surface Mounted Devices, defines the requirements for qualifying the moisture sensitivity level of a plastic SMD and meets the intent of JEDEC A112, Moisture Induced Stress Sensitivity for Plastic Surface Mounted Devices, and JEDEC A113, Preconditioning of Plastic Surface Mounted Devices Prior to Reliability Testing.

STORAGE REQUIREMENTS AND TIME LIMITS OUT OF DRYPACK

The qualified moisture sensitivity level for each SMD determines the appropriate storage requirements and time limits once out of drypack. Table 1 relates the moisture sensitivity (MS) level to the storage environment and time limits. If these limits are exceeded once the drypack is removed, then the effected SMDs must undergo a dry–out procedure prior to any reflow process.

Table 1.

MS Level	Drypack	Storage TH	Time Out of Drypack
1	No	30°C / 90% RH	Indefinite
2	Yes	30°C / 60% RH	One Year
3	Yes	30°C / 60% RH	168 Hours Max
4	Yes	30°C / 60% RH	72 Hours Max
5	Yes	30°C / 60% RH	24 Hours Max
6	Yes	30°C / 60% RH	6 Hours Max

OPTIONAL STORAGE METHODS OUT OF DRYPACK

If the customer cannot mount the SMDs within the specified time limit, or factory ambient conditions exceed the specified maximum temperature and/or humidity level, then the customer can abate moisture absorption by immediately storing the SMDs at less than 20% RH. Any of the following storage methods may be used.

Store the SMDs in a rigid metal container with a tight fitting lid. Place fresh desiccant (as a minimum, the equivalent of one Motorola desiccant bag per every 0.8 cubic feet) in the storage container. Desiccant is readily available at any chemical supply house. An RH indicator strip must be kept inside the container to verify that the humidity level remains below 20 percent.

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Store the SMDs in a dry nitrogen purge cabinet or container that maintains the humidity level at less than 20 % RH.

For short term storage, SMDs can be resealed in the original drypack bag soon after opening. Bags opened carefully near the seal are easily resealed with either a heat seal or a tight fitting clip. Fresh desiccant may be required in equal proportion to the amount originally shipped with the bag. An RH indicator strip must be kept inside the bag to verify that the humidity level remains below 20% RH.

DRY–OUT PROCEDURES

SMDs that are not handled or stored within specification must undergo one of the following dry–out procedures prior to reflow.

125°C DRY–OUT BAKE

Bake TSOPs at 125°C (± 5°C) for four hours (+1/–0 hour). Bake all other SMDs at 125°C (± 5°C) for eight hours (+1/–0 hour). CAUTION:Do not bake SMDs in shipping trays with a temperature rating of less than 130°C. Do not bake SMDs in plastic tubes or tape and reel (T & R) packaging. Use care in handling SMDs out of their shipping container to maintain lead coplanarity.

40°C DRY–OUT BAKE

Bake TSOPs at 40°C (± 5°C) for 96 hours (± eight hours). Bake all other SMDs at 40°C (± 5°C) for 168 hours (± eight hours). NOTE: This bake is designed for SMDs in plastic tubes or T&R, and is best achieved in a dry nitrogen purge oven. Higher temperatures warp or melt plastic tubes and T&R cover tape separates from carrier tape at 60°C.

ROOM TEMPERATURE DRY–OUT

Store units per Optional Storage Methods for a minimum of 500 hours. This drying method is designed for SMDs in plastic tubes or T&R when a 40°C dry–out bake is not possible or desirable.

NOTE:
The customer must apply the same storage requirements and time limits specified in Storage Requirements to all dried SMDs

SOLDER REFLOW PROFILES

The following guidelines do not necessarily indicate the temperature extremes that can safely be applied to SMDs. In most cases and SMD can withstand higher temperatures than the standard PC board. These guidelines represent good soldering practices that will yield high quality assemblies and minimize rework.

VAPOR PHASE REFLOW

Preheat leads to a nominal temperature of 150°C at a maximum rate of 2°C per second.

Operate the reflow chamber between 215°C and 220°C maximum, with a nominal dwell time of 50 to 80 seconds above the eutectic tin/lead solder melting pint of 183°C. Dwell times should not exceed 120 seconds above the eutectic tin/lead solder melting point of 183°C.

NOTE:
Some vapor phase machines cannot provide preheat, and therefore subject boards and components to rather severe thermal shocks.

INFRARED REFLOW

Preheat leads to a temperature of 100°C minimum and a 140°C maximum rate of 2°C per second.

Generate peak lead temperatures between 205°C minimum and 235°C with a nominal dwell time of 50 to 80 seconds above the eutectic tin/lead solder melting point of 183°C. Dwell times should not exceed 120 seconds above the eutectic tin/lead solder melting point of 183°C.

NOTE:
Peak temperatures can vary greatly across the PC board during IR processes. The variables that contribute to this wide temperature range include the furnace type and the size, mass and relative location of the components on the board. Profiles must be carefully tested to determine the hottest and coolest points on the board. The hottest and coolest points should fall within the recommended temperatures. Thermocouples must be carefully attached directly to the solder joint interface between the package leads and the board with very small amounts of thermally conductive grease or epoxy.

WAVE SOLDER

Preheat leads to a temperature of 100°C minimum and 140°C maximum at a maximum rate of 2°C per second.

Generate a solder wave temperature of 245°C nominal, 265°C maximum, with a nominal dwell time of two to three seconds and a maximum dwell time of five seconds

NOTE:
The wave solder process is suitable for the SOIC, but it is not recommended for PLCC, SOJ, QFP, TSOP, PQFP, TQFP or CQFP because of the high rate of bridging and 0pen solder joints caused by shadowing effects. Thermal shock is much greater if the whole body is immersed in molten solder. Wave solder immersion tests have not been conducted on large PLCC, QFP, PQFP, TQFP and CQFP.

REFERENCE DOCUMENTS

JEDEC Test Method A112, “Moisture Induced Stress Sensitivity for Plastic Surface Mounted Devices.” JEDEC Test Method A113, “Preconditioning of Plastic Surface Mounted Devices Prior to Reliability Testing.” Motorola 12MRE20040W, “Moisture Characterization and Preconditioning of Plastic Surface Mounted Devices.”

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