Handling Moisture Sensitive Surface Mount LED

Application Note 5305

1. Introduction

Surface mount devices (SMDs) are generally sensitive to moisture absorption. Moisture from atmospheric humidity enters permeable packaging materials by diffusion. The assembly processes used to solder SMD packages to board exposes the entire package body to temperature ranges between 210 °C to 260 °C. During solder reflow, the combination of rapid moisture expansion, material mismatch, and material interface degradation can result in epoxy cracking (or crazing) and induce internal package delamination that could lead to reliability failure.

The objective of this application note is to provide SMD users with recommended methods for handling and using moisture sensitive surface mount LED packages according to Moisture Sensitivity Level (MSL) classification.

2. Reference Documents

IPC/JEDEC J-STD-020: Moisture/Reflow Sensitivity Classification for Non-Hermetic Solid State Surface Mount Devices.

IPC/JEDEC J-STD-033B: Standard for Handling and Shipping of Moisture/Reflow Sensitive Surface Mount Devices.

The guidelines for classification, handling, packing, shipping and use of SMDs are defined clearly in the industrial standard J-STD-020 and J-STD-033B, a joint publication of the IPC — Association Connecting Electronics Industries and the Joint Electronic Device Engineering Council (JEDEC).

In summary, the standards require that SMDs be properly classified, identified and packaged in dry bags until ready for PCB assembly. Once the bags are opened, each device must be assembled and reflowed within a specific timeframe. The standard requires that total cumulative exposure time for each reel or tray of SMDs be tracked through the complete manufacturing process until all components are placed prior to reflow. Proper material logistics should effectively minimize exposure time during storage, kitting, staging, etc.

3. Moisture Sensitive Level Classification

Different package types exhibit different sensitivity levels to moisture ingress and its effects. The older, through-hole, bulkier packages absorb moisture per volume at a slower rate than the thinner surface-mount packages of recent times.

The problem with moisture absorption and retention inside the package is that the trapped moisture will vaporize and exert tremendous internal package stresses when the device is subjected to sudden, elevated temperature, such as during board mounting. Package cracking due to such moisture-induced stresses is generally known as popcorn phenomenon.

In general, SMDs are more prone to popcorn cracking because:

a. They are thinner and therefore have lower fracture strength;

b. They absorb and retain moisture more easily; and

c. SMD board mounting process also subjects the molding compound to the high temperature experienced by the leads.

In recognition of the varying degrees of popcorn tendency of various package types, IPC/JEDEC defined a standard classification of moisture sensitivity levels (MSL). The MSL is expressed in numbers, where the MSL number increasing with the vulnerability of the package to popcorn phenomenon. Thus, MSL1 correspond to packages that are immune to popcorn cracking regardless of exposure to moisture, while MSL5 and MSL6 devices are most prone to moisture-induced fracture.

Table 1 below shows the MSL definitions per IPC/JEDEC J-STD-020.

Level	Floor life*
1	Unlimited at ≤30°C/85% RH
2	1 year
2a	4 weeks
3	168 hours
4	72 hours
5	48 hours
5a	24 hours
6	Mandatory bake before use. After bake, must be reflowed within the time limit specified on the label

Notes:

* (out of bag) at factory ambient of ≤ 30°C/60% RH or as stated

The amount of time that the SMDs are exposed to ambient environment after removing from sealed Moisture Barrier Bag (MBB) is known as floor life. All high temperature related processes including solder reflow, wave soldering and rework must be completed within the specified floor life.

4. Packing of Moisture Sensitive Surface Mount Devices

Table 2 below shows the packing requirement for SMD as stated in J-STD-033B.

Level	Dry before bag	MBB with HIC*	Desiccant	MSID** label	Caution label
1	Optional	Optional	Optional	Not Required	Not required if classified at 220°C - 225°C Required if classified at other than 220°C - 225°C
2	Optional	Required	Required	Required	Required
2a – 5a	Required	Required	Required	Required	Required
6	Optional	Optional	Optional	Required	Required

* HIC = humidity indicator card
** MSID = Moisture Sensitive Identification label

Figure 1a. Moisture barrier bag, MSID and Caution label

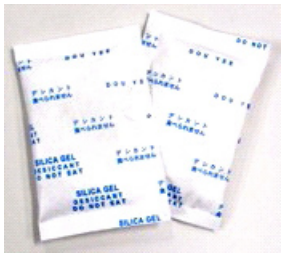

Figure 1b. Desiccant

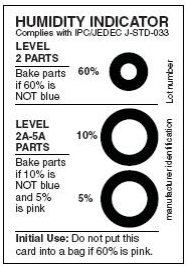

Figure 1c. HIC

5. Handling Moisture Sensitive Surface Mount Devices

Precautions need to be taken when handling moisture sensitive SMDs as early as during storage until all heat related assembly processes are completed. Failure to comply with appropriate precautionary measures might lead to premature failure of the product.

5.1 Storage before use

The minimum calculated shelf life is 12 months (at <40°C and 90% RH) from bag seal date. If the actual shelf life has exceeded 12 months and the humidity indicator card (HIC) indicates that baking is not required, then it is safe to reflow the components per the original MSL rating. It is not recommended to open the MBB prior to assembly (e.g. for IQC). If it is unavoidable, the device should then be properly sealed in MBB with desiccant and new HIC. The exposed duration should be taken in as floor life.

5.2 Control after opening the MBB

The HIC shall be read immediately upon removal from MBB to determine if there is excessive humidity in the MBB. The component floor life need to be tightly controlled in order not to exceed maximum allowable duration as stated in Table 1. Floor life is cumulative every time the SMDs are exposed to ambient environment, unless being baked.

5.3 Control for unfinished reel

If a reel of SMDs is unable to be completely consumed, the left over units should be stored in:

a. Sealed MBB with desiccant;

b. Dry cabinet / desiccator at <5%RH if not sealed in MBB with desiccant.

The floor life can be paused if stored at above conditions but shall not be reset.

5.4 Control of assembled boards (staging)

If the PCB assembled with moisture sensitive SMDs is not to be reflowed or subjected to other high temperature processes again, special handling is not required. However, if the PCB is deemed to be subjected to multiple reflow passes, or any other high temperature processes including rework, care must be taken to ensure no SMD mounted or unmounted have exceeded their floor life prior to the final pass. The floor life is NOT reset by any reflow or rework process.

5.5 Pausing or resetting the floor life

As mentioned, floor life clock of SMD is cumulative and can be paused or stopped by storing the SMD under dry environment of <5%RH. If the cumulative floor life exposure is greater than specification in Table 1, the floor life clock needs to be reset by baking the units.

5.6 Reusing the desiccant

The desiccant supplied in the MBB may be reused if the total desiccant exposure time is not greater than 30 minutes.

5.7 Reading HIC

Blue dots indicate dry condition while pink dots indicate existence of moisture.

a. Change desiccant if 5% dot indicates pink

b. “10%” is Not blue and “5%” HIC indicator turns pink.

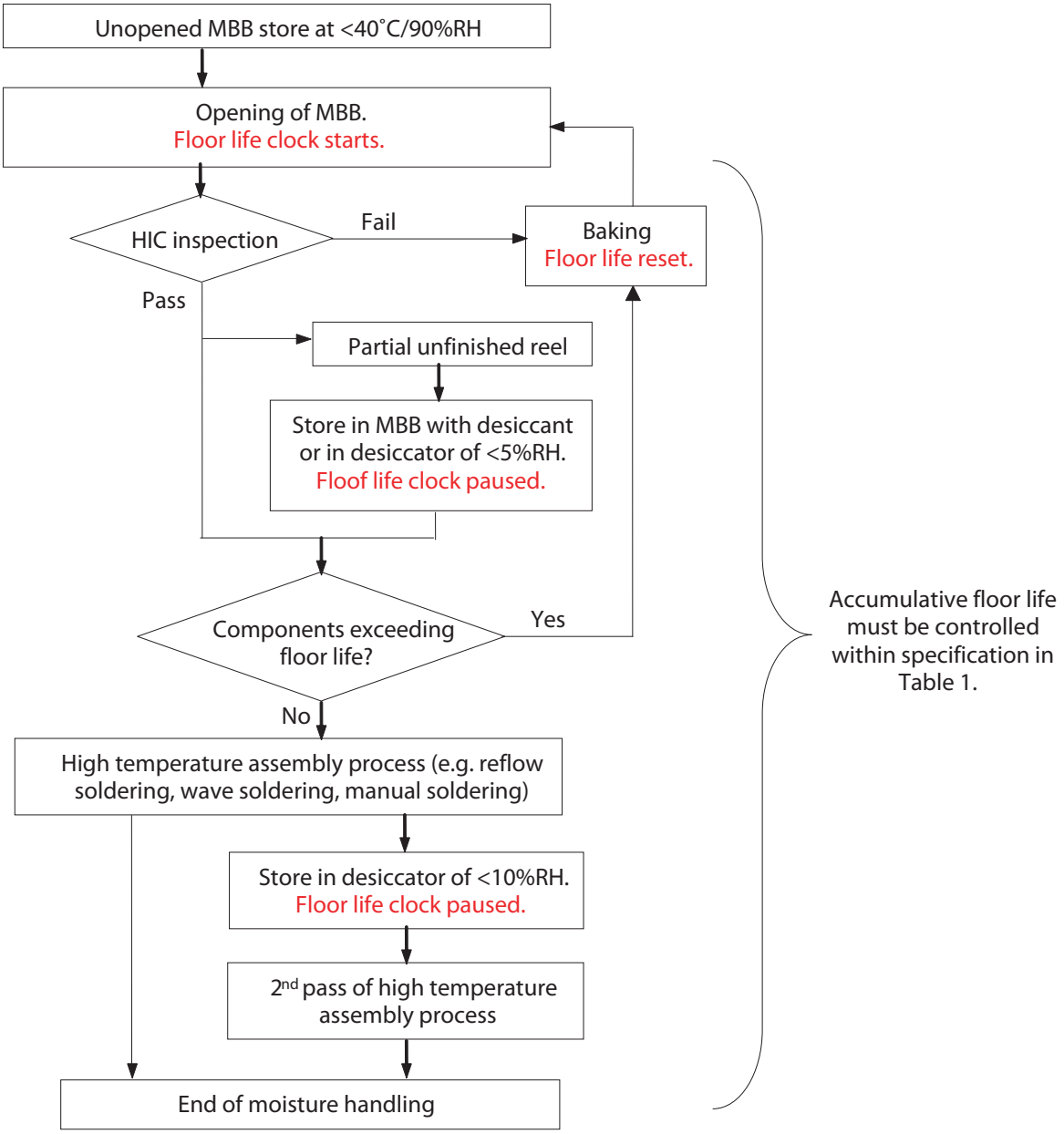

Figure 2. Summarize flow chart of moisture handling of SMDs.

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

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