PCB PACKAGING FOR LEAD FREE ASSEMBLY

Background

Because of the recent implementation of environmental standards, such as RoHS, WEEE, and others in 2006, the use of a lead-free assembly compatible laminate material is now required. The laminate material must withstand the increased temperatures of lead-free assembly without evidence of delamination of the base material. The temperatures for a typical tin-lead assembly process compared to a lead-free assembly have increased 20ºC to 50ºC and thus present unique challenges that require special attention by users during PCB processing, packaging, storage, and lead-free assembly processing.

Control of moisture/volatiles in the base material is one of the most critical aspects of manufacturing a lead-free PCB assembly. The vapor pressure of water increases dramatically from approximately 300 PSI to over 600 PSI resulting in stresses that can easily over come the bonds at critical laminate interfaces when the Maximum Moisture Content (MMC) is exceeded. Recent studies by Isola have demonstrated that there is a functional limit to the amount of moisture/volatile that can be allowed in the substrate before the onset of delamination will occur during lead-free assembly.

There is no easy solution for solving moisture/volatile issue. Since laminate materials will absorb moisture/volatile, Isola strongly recommends implementing best practices for PCB packaging, storage, handling, assembly, and rework address this problem. The objective of this technical bulletin is to offer best practice recommendations to our valued customers.

PCB Fabrication and Assembly

This information is contained in the following Isola Technical Bulletin which can be downloaded off our website at www.isola-group.com.

ISOLA LEAD-FREE PWB & ASSEMBLY GUIDELINES

PCB Dry Packaging

Proper packaging of the lead-free compatible PCB is critical. The packaging system must be carefully developed by the PCB fabricator to protect the PCB from atmospheric moisture that may enter the packaing materials by diffusion. The packaging system should be develop to offer a shelf life of 12 months at ≤40ºC and 90% RH.

Selection of Packaging Materials

Selection of the proper packaging material is critical. The packaging engineer must balance many factors including cost and protection in making the proper selection of materials. The engineer should develop a full understanding of the entire process and packaing system in order to ensure the product is protected properly during shipment and storage. The information contained within this bulletin are a guideline and should not be used to replace a complete undetstanding of the packaging systems available in the market place.

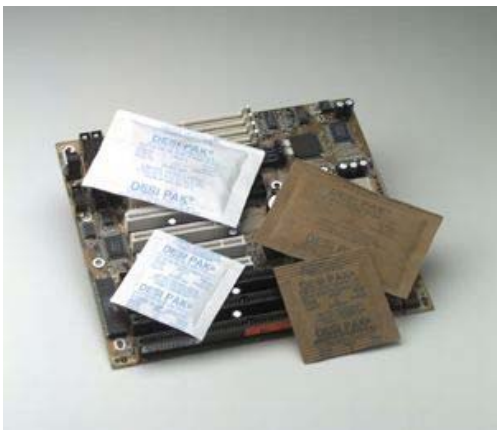
Packaging Bags

a. Moisture Barrier Bags should be used to package PCB's bound for lead-free assembly processing.
b. The Water Vapor Transmission Rate (WVTR) should meet EIA 583, Class 1 which has a WVTR ≤0.02g / 100in^2 / 24hr.
c. The bag should be selected to meet the requirements of MIL-PRF-81705, Type I for flexibility, ESD protection, mechanical strength, and puncture resistance.
d. The bags should be heat sealable under vacuum with an appropriate seal width per manufacturers recommendations.

Note: The WVTR should measured per ASTM F 1249 which defines the rate at which moisture passes through the barrier. Bags are available with much lower WVTR values that provide greater protection and may be considered to increase shelf life of the PCB package and reduce desiccant loading requirements

Desiccant

a. The desiccant material should be selected to meet MIL-D-3464, Type II for a dustless, non-corrosive, and absorbent that meets the standard.
b. Proper selection of the desiccant should include consideration of the environmental conditions during shipping as these may effect the function of specific desiccant materials.
c. Check with your desiccant supplier for moisture capacity capability in 'units'.



Note: Handling of desiccants is critical. The moisture absorbtion capability of desiccant packets can be diminished by up to 25% within 1 hour or less depending on the relative humidity of the environment. Care should be taken to ensure desiccant packets are stored and handled properly to ensure maximum effectiveness.

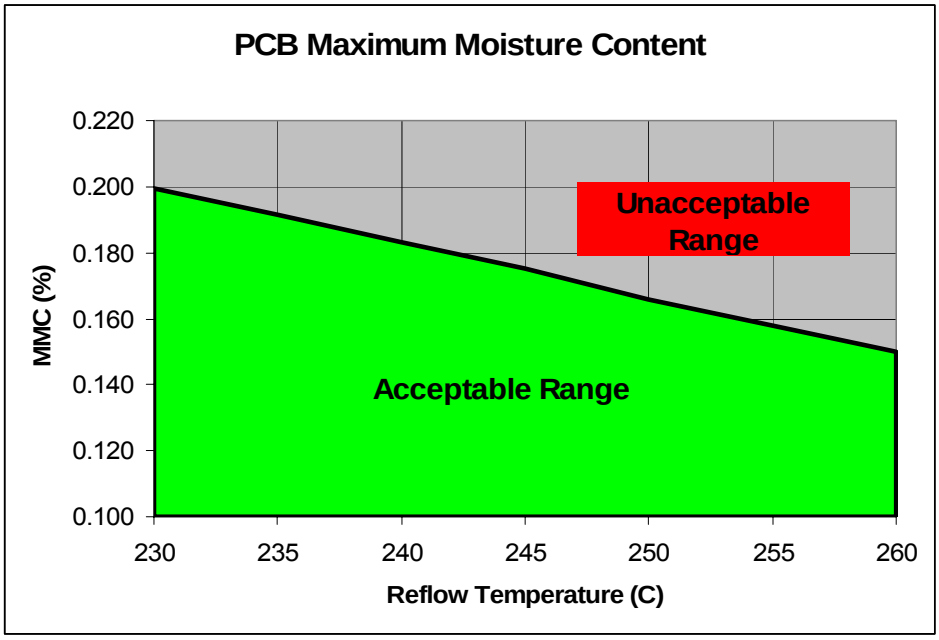
Humidity Indicator Cards

The HIC should comply with MIL-I-8835 and, at a minimum, have three color dots with sensitivity values of 30% RH, 40% RH, and 50% RH.

Preparation for Packaging

Prior to packaging, the PCB must be clean and dry. A typical PCB process already has several baking steps. However, these steps may not be adequate to ensure the PCB product is adequately moisture/volatile free prior to packaging.

The PCB fabricator is strongly advised to determine the Maximum Moisture Content (MMC)/volatile of the product immediately prior to PCB packaging. Please contact Isola for test methods.



If the PCB has a residual moisture/volatile content that exceeds these levels, the PCB lot should be baked prior to packaging.

- Consult your surface finish supplier for maximum baking temperatures and dwell times.
- Bake tables for moisture removal at various temperatures for Isola products can be supplied upon request.

PCB Packaging

PCB's should be vacuum packed in a with adequate desiccant and humidity indicator card.

a. PCB's should be packaged immediately after final inspection. The exposure time for the PCB prior to packaging should be minimized to eliminate the potential for moisture/volatile absorbtion as defined above.
b. Moisture Barrier bags must be hermetically heat sealed with an adequate seal width per manufacturers recommendations to ensure proper bag performance.
c. One humidity indicator card should be placed in the bag with the PCB's.
d. Instructions on the interpretation of the HIC after opening the package should be printed on a sticker and adheared to the bag exterior. Isola recommends a maximum of 40% RH Maximum Interior Humidity (MIH).
e. The HIC should be placed adjacent to the desiccant, not on top of the packet(s).
f. The amount of desiccant should provide protection for a minimum of one year.
g. Other packaging materials used in the bag will also have a moisture content. The moisture/volatile content of these materials must be considered in calculating the number of desiccant packets to be used

Determining Desiccant Requirements

To determine the proper quanity of desiccant 'units' to be used in the bag, use the following formula.

Units = (0.231 x Bag Surface Area x Bag WVTR x Months) / Moisture Capacity

Example:

- 8" x 10" MBB x 2 sides = 160 in^2
- 0.02 WVTR
- 12 months Storage
- At 40% MIH, the moisture capacity = 6.2 g/unit

Units = (0.231 x 160 in^2 x 0.02 WVTR x 12 months) / (6.2g / unit)

Units = 1.4 desiccants ≈ 2 units

Storage of Dry Packed PCB's

When using the right packaging materials and maintaing bag integrity, PCB's can be stored for up to one year without absorbing excess moisture/volatile. A few precautions should be taken to ensure package integrity is maintained during storage.

a. Packages of PCB's in MBB packaging should be clearly labeled with packaging date and expiration dates.
b. Containers of MMB packaged PCB's should be stored in clean, dry warehouse environment.
c. Containers should be properly stored as not to cause damage to the MBB packaging.
d. Individual packages of PCB's should be stored so that damage does not occur to the MMB packaging.
e. Storage conditions should be <40ºC and <90% RH

PCB Floor Life for Assembly above 220ºC

The rate of moisture/volatile absorption of a PCB is dependent on the resin system, board design, and environmental conditions and therefore so is the floor life of the product. Based on internal testing and worst case combination of variables, Isola is recommending that the maximum floor life of the PCB should be maintained at no more than 168 hours or one week when the environmental conditions are maintained at or below 30ºC and 60% RH.

Once the assembly process has been initiated, follow the requirements for surface mounted compoments and floor life limitations.