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## **Implementation of Lead-Free Modules At Microsemi Power Products Group - Modules Compliance with the RoHS 2002/95 Directive**

### **BACKGROUND:**

In response to increased conscientiousness for environmental preservation across the globe, the need for highly reliable lead-free components suitable for use in electronic assemblies is receiving increasing attention within the semiconductor manufacturing industry. This paper explains Microsemi Power Products Group approach to developing solutions to address this concern with our Module products.

Microsemi Power Products Group (Modules) is actively involved in developing, for all our customers, products that meet the requirements of the RoHS 2002/95 Directive and more specifically the requirements of a lead-free assembly.

While Microsemi Power Products Group (Modules) is in the transition phase, we will strive to minimize any impact on our customers that the move to RoHS compliant products will entail. To this end, we look forward to working with all our customers to understand their specific needs and to assure that the conversion takes place smoothly and efficiently.

The RoHS program at Microsemi Power Products Group (Modules) will be conducted as follows :

### **1. LEAD-FREE SOLDER ATTACH PROCESSES**

#### **Die Attach**

Most of Microsemi Power Products Group (Modules) are processed with die attach solder alloys containing more than 85% lead. Microsemi Power Products Group (Modules) is testing potential high-temperature, high-strength lead-free solder materials as SnAg and SnAgCu. Other candidates are being considered for high rel applications, as AuSn solder material. Evaluation is conducted to select the materials meeting Microsemi Power Products Group (Modules) targets for performance and reliability.

Regardless the solution that Microsemi Power Products Group (Modules) will select for a lead-free die attach process, and based upon the RoHS exemption for solder alloy with lead content greater than 85%, Microsemi Power Products Group (Modules) will continue to offer the current die attach material (92.5Pb/Sn/Ag) for applications requiring specifically the use of such alloy.

#### **DBC substrate Attach, Terminal and Component Attach**

Current Sn60Pb40 and Sn62Pb36Ag2 solders are being replaced by lead-free solder; several candidates are being evaluated as SnAg, SnAgCu materials. Other potential solder materials will be reviewed as they become available.

## **Component Attach onto PCB implemented into a Module**

Assembly of SMD or Discretes components onto Printed Circuit Board is performed by external contractors. Microsemi Power Products Group (Modules) is working closely with these contractors and reviewing their internal Lead-free program.

Only subcontractors meeting the RoHS requirements, with a quality level equal or exceeding the current one, will be kept as qualified suppliers. Microsemi Power Products Group (Modules) will request records from these contractors as evidence of lead-free program completion.

## **2. MATERIAL COMPLIANCE WITH RoHS DIRECTIVE**

For any material used in Module assembly, Microsemi Power Products Group (Modules) is reviewing compliance with the requirements of RoHS Directive ; this includes presence of lead substance, but also mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) prohibited substances that could be present in components or chemical compounds incorporated into our Modules.

### **Terminal finish**

All the terminals used for our Standard Modules are already lead-free, as they are Nickel plated with or without Gold or pure Tin over-plating. No change is planned on these terminals.

Some terminals used in ASPM products are plated with Sn95Pb5 on top of a Nickel layer, in order to increase their solder wetting capability. In these specific cases, the Sn95Pb5 final plating will be converted to a lead free solution, the candidates being pure Tin, or Au, or SnBi, or SnAg, or SnAgCu plating. Terminals dimensions and pin-out location will not be affected by this change.

For all the Modules designed to be attached onto Printed Circuit Boards thanks to solder wave process, and since typical reflow temperatures of lead-free materials are higher than traditional lead-tin solders, Microsemi Power Products Group (Modules) will characterize its relevant packages using elevated reflow temperatures (245°C-260°C).

### **Other components and chemical compounds**

Compliance of every element used for Module assembly is being checked ; vendors are contacted and requested to provide evidence of compliance to RoHS requirements.

As an example, some copper pastes used for thick-film screen-print technology contain Cadmium; such pastes are being replaced by Cadmium free material, proposed by the vendor and evaluated to meet Microsemi Power Products Group (Modules) requirements.

Records will be kept by Microsemi Power Products Group (Modules) to demonstrate that the selected elements are all compliant with the RoHS requirements; these records will be used at our incoming inspection stage to prevent any entry of unapproved material or source of supply.

## **3. QUALIFICATION / RELIABILITY TEST :**

Performance and reliability of the Modules made with the new solder material, new terminals finish and any other changes will be tested, with the target to meet or exceed the current performance and reliability of our Modules.

Reliability testing will be performed on test vehicles and will comprehend at least the following testing methods :

- power cycling
- temperature cycling
- temperature shocks

Evaluation will also use other inspection methods as micro-sectioning and structural analysis.

#### **4. TRANSITION PLAN/NOTIFICATION TO CUSTOMERS:**

Schedule :

We plan that all the changes detailed above will be internally evaluated during 2005. By the end of Q3/2005, Microsemi Power Products Group (Modules) will have the capability to provide Lead-free products to customers for evaluation and tests.

Our target is to give all our customers the means to convert to these new products before July 2006.

Marking :

A specific marking onto the Module will indicate that all the changes are implemented, as the sign of a clean Module complying with the RoHS 2002/95 Directive.

Marking will also advise if the module is fully lead-free (including die attach with lead-free solder material) or if the module is complying with the RoHS 2002/95 Directive with the exception of the die attach solder still performed with solder alloy containing more than 85% lead.

Notification of changes :

For Standard Modules: as the changes will be performed only inside the module (no change on the terminals), customers will be notified about the changes by the product marking only.

For Application Specific Power Module (ASPM® products), customers will be notified of any change in order to evaluate and agree on its implementation.