



MICREL, INC.
1849 Fortune Drive
San Jose, CA 95131

Micrel's Lead (Pb)- Free Product Information

Background

Demand has been increasing for "lead (Pb)-free" product primarily in response to two European directives: Waste from Electrical and Electronic Equipment (WEEE) and Restriction on Hazardous Substances (RoHS). In addition, there are companies wishing to provide "green" or environmentally friendly consumer products.

Where is lead (Pb) used in Micrel's products?

Lead (Pb) is used in two ways. First, it is used as component in the electroplated solder finish on the lead or terminations of leaded and leadless packages. Typically, the lead finish is 15-20% lead (Pb) and 80-85% tin (Sn). Secondly, lead (Pb) is used as a component in the high melting temperature solder die attach used in TO-263, TO-220, and some SOT-223 packages. These high power packages require solder to provide good thermal conduction between the die and the leadframe.

What does lead (Pb)-free mean?

At Micrel, lead (Pb)-free means no intentional additions of lead bearing materials to the product. Lead (Pb) may be present as a low level constituent of other metals in the package construction. In this sense, we believe the lead (Pb) content in a lead (Pb)-free package is less than 0.01 wt.% of the total device weight.

Are there any exceptions?

Yes! The RoHS directive provides several exemptions to the ban on lead (Pb) allowing lead (Pb) to remain in the product and be compliant with the directive.

Lead (Pb) exemptions relevant to Micrel

Lead (Pb) in high melting type solders (Pb>85% and Melting Point > 260C). This means the solder used in the die attach of TO-263's, TO-220's, and SOT-223's is exempt.



MICREL, INC.
1849 Fortune Drive
San Jose, CA 95131

Lead (Pb) in servers, storage, and storage systems until 2010.

Lead (Pb) in high-end networking and telecommunications products.

Other exemptions

Lead (Pb) in ceramic electronic components

Lead (Pb) as an alloying element in steel

Lead (Pb) in the glass of CRT's, electronic parts, and fluorescent tubes.

When will Micrel provide lead (Pb) – free product?

Micrel is providing Lead (Pb)-free product today. Our choice of lead (Pb)-free lead finish is matte tin (Sn). Depending on supplier our lead (Pb)-free leadless plastic packages (MLF) may have either tin (Sn) or palladium-nickel (Pd-Ni) finish.

For high power packages (TO-263, TO-220, SOT-223) we plan to offer tin (Sn) lead finish while continuing to use the exempted high melting point solder for die attach. We believe that these devices will be in compliance with the European directives but will not be strictly speaking "lead (Pb)-free". For a high power package without intentional additions of lead (Pb), we would substitute high thermal conductivity epoxy die attach material for the solder die attach. This solution may be viable up to 3 amps. For products with higher power dissipation there is no alternative identified for the solder die attach with equivalent power dissipation.

Micrel is currently taking orders for lead (Pb)-free product. We are offering both lead (Pb) and lead (Pb)-free versions of our products. In the future, when the demand for lead (Pb)-free becomes significant we may choose to convert entire package styles or product lines to the lead (Pb)-free version.

How do I know if a product is lead (Pb)-free?

Micrel is using a new part number to identify lead (Pb) from lead (Pb)-free product. Micrel intends to be able to distinguish lead finishes from the package marking. Typically, we are changing the temperature code of the device.



MICREL, INC.
1849 Fortune Drive
San Jose, CA 95131

For example, the lead (Pb)-free version of the MIC5205BM would be MIC5205YM. The temperature codes of A, B, C would be replaced by X, Y, Z for lead (Pb)-free.

In the case of TO-263, TO-220, and SOT223 we intend to provide RoHS compliant product (tin (Sn) lead finish with the exempt lead (Pb) containing solder die attach). Again, we would change the product name and marking to identify the RoHS compliant product.

What about the reliability of lead (Pb) – free product?

Tin was the industry standard lead finish prior to the adoption of solder. In this regard, tin (Sn) is proven as a lead finish material giving acceptable solderability and solder joint performance.

In our view, the greatest concern is that higher reflow temperatures are required for the higher melting temperatures of the lead (Pb)-free solders. The reliability of moisture sensitive product is a function of peak reflow temperature. As a result, Micrel has determined moisture sensitivity levels of packages at the higher lead (Pb)-free temperatures. In some cases, this has resulted in lower moisture sensitivity levels. The peak reflow temperature used for this evaluation is 260C.

Tin whiskers have also been highlighted in various industry meetings as a potential problem. At this time, there is no recognized domestic or international test method for accelerating or assessing tin whisker growth. Examples have been produced showing whisker growth on lead (Pb)-tin (Sn) solder, tin (Sn) – bismuth (Bi), and pure tin (Sn) that has further clouded the issue.

How do I order lead (Pb) – free product?

Today, Micrel is providing lead (Pb) – free product on an as needed basis. Contact your local sales office for minimum order quantities, pricing, and lead times. As the use of lead (Pb) – free product increases Micrel may in the future choose to convert all products in a particular package or product line to lead (Pb) –free. Micrel would notify customers through a product/process change notification.



MICREL, INC.
1849 Fortune Drive
San Jose, CA 95131

What is Micrel's position on eliminating brominated fire retardants and antimony based fire retardants in mold compounds?

The RoHS directive calls for the elimination of polybrominated biphenyls (PBB) and polybrominated diphenyl ether (PBDE) by 2006. It is our understanding that these materials are not used as flame retardants in mold compounds that are used by Micrel. However, other brominated flame retardants are used as are antimony based flame retardants. These materials are not currently scheduled for elimination in the RoHS directive. Micrel continues to monitor this situation.

Micrel is currently using Sumitomo G700 mold compound in the E-pad TQFP package. This material does not contain bromine or antimony based flame retardants and uses aromatic resin chemistry to provide flame retardant activity. G700 is a qualified "green" compound and available today and Micrel believes similar compounds will be available in the future to fulfill demand for "green" compounds if it emerges.

June 3, 2003