



MICREL, INC.
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Micrel's Lead (Pb)- Free and ROHS Compliance Statement

Background

Demand has been increasing for "lead (Pb)-free" and "RoHS compliant" product primarily in response to two European directives: Waste from Electrical and Electronic Equipment (WEEE) and Restriction on Hazardous Substances (RoHS). RoHS mandates that by July 2006 European states will ensure that all electrical and electronic equipment put on the market contains no lead, mercury, cadmium, chromium, or PBB's or PBDE's (two types of brominated flame retardants).

Does Micrel have RoHS compliant product?

Yes. All Micrel products that are sold as Pb-free are RoHS compliant. RoHS compliant products meet the RoHS requirements for lead, mercury, cadmium, chromium, PBB's, and PBDE's. All current products are available in Pb-free/RoHS compliant versions.

Is Micrel product compliant with the moisture sensitivity standard IPC/Jedec J-STD-020C?

Yes. All Micrel product including Pb-free and RoHS compliant product is compliant with J-STD-020C. In some cases the moisture sensitivity rating of some products has decreased due to the 260C reflow temperature for Pb-free systems. Moisture sensitivity rating for all Micrel packages can be found at www.micrel.com in the quality and reliability section.

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.



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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. All Pb-free products are RoHS compliant.

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 RoHS 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.

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/RoHS compliant product?

Micrel is providing Lead (Pb)-free/RoHS compliant product today. Micrel uses two primary Pb-free plating options, matte tin (Sn) or nickel-palladium-gold (NiPdAu). When Micrel uses bromine free mold compounds in conjunction with the nickel-palladium-gold lead finish, we term these products "green". All Micrel



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products may be ordered today as Pb-free/RoHS compliant today. Our matte tin finish and our palladium nickel finish are RoHS compliant.

For high power packages (TO-263, TO-220, SOT-223) we plan to offer Pb-free lead finish while continuing to use the exempted high melting point solder for die attach. We believe that these devices are RoHS compliant but not 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/RoHS compliant product. We continue to support 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 and RoHS compliant? Does Micrel use a unique part marking scheme for Pb-free?

Micrel is using a new part number to identify lead (Pb) from lead (Pb)-free/RoHS compliant product. Micrel intends to be able to distinguish RoHS compliant product from the package marking. Typically, we are changing the temperature code of the device. The table below shows the marking scheme.

| | "Green" Package | Pb-free, ROHS Compliant | Standard Product | | |
|---|------------------------------|----------------------------------|-----------------------------------|---------|----------|
| | | | Analog | HBW | Ethernet |
| Part Numbers | | | MICxxxxx | Syxxxxx | KSxxxxx |
| Maximum IR Reflow Temperature | 260C | 260C | 240C* | | |
| Mold Compound Composition | Without Organic Bromide/SbO3 | May contain organic bromide/SbO3 | May contain organic bromide/SbO3 | | |
| Lead Finish | Pd/Ni/Au | PdNiAu or 100% matte Sn | Pd/Ni/Au or Sn/Pb (85/15 or 8020) | | |
| Temperature Code and PB Free Mark** | | | | | |
| Commercial | H | Z | C | C | no code |
| Industrial | G | Y | B | I | I |
| Military | F | X | A | - | - |
| Industrial ROHS Compliant with high melting Pb/Sn solder die attach | | W | | | |
| * - Many standard products will withstand 260C. Check with the factory if this is a requirement | | | | | |
| ** - For Ethernet the Pb-free mark will be the letter following the KS prefix (e.g. KSZ8721BL). For Analog and HBW the letter designated for operating temperature range in the standard part marking will be replaced by the appropriate Pb-free temperature code. | | | | | |



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Micrel's high bandwidth product line (typically products starting with part numbers SY...) will primarily use the palladium nickel finish. In some cases we will be converting customers from matte tin versions ("Y" designator) of these products to the palladium nickel lead finish ("G" designator). See PPCN040008. Most analog products are available in a matte tin version. Moving forward we may convert many of these to NiPdAu, also.

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. Micrel has performed reliability tests of the matte tin finish using both lead-free and tin-lead solder pastes. Reliability testing includes moisture level determination at 260C reflow, temperature cycling, humidity test testing, wettability, solderability, whisker testing, and solder joint strength. Reliability information is posted on the web at www.micrel.com under the quality and reliability section.

PdNiAu has also been in use by the semiconductor industry for many years. There are no whisker issues with PdNiAu. Reliability information for PdNiAu will be posted on the web.

What about Tin Whiskers?

Micrel has adopted the NEMI recommended, 150C, 24-hour post plating anneal, to suppress whisker formation. Whisker testing performed by Micrel has shown that annealing is effective in reducing the occurrence of tin whiskers.

There are no whisker issues with PdNiAu.

Is matte Tin and NiPdAu backward compatible with existing PCB solder pastes?

Yes. With minor adjustments in temperature profiles we believe that Micrel Pb-free lead finishes can be used with standard solder systems and in mixed solder systems.



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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.

Will Micrel issue a Product Change Notice (PCN) to its customers?

Micrel is changing the part numbers of the Pb-free/RoHS compliant product. Customers will order a new part number so nothing has changed with respect to the old part number. 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 at that time. All Micrel products are available in Pb-free versions that customers may order at any time.

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. All Micrel mold compounds used today are compliant with the RoHS directive. Micrel continues to monitor this situation.

Micrel’s “green” products are bromine free and use whisker-free palladium-nickel-gold lead finish.

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