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## Lead (Pb) Free Program and RoHS Compliance Information

Our products with a #PBF or #TRPBF are RoHS and WEEE compliant.

Matte Tin is our Lead-Free terminal finish.

All Matte Tin products are marked with a special identifier on the top mark and labels.

Matte Tin terminal finish is available on all our products under special flow #PBF or #TRPBF.

Matte Tin terminal finish is backward and forward compatible with the industry standard soldering conditions and solder paste for Leaded or Lead-Free terminal finish.

For customers who do not plan on converting to Matte Tin, solder plated products will continue to be offered in the foreseeable future



### See Below for Details

#### Lead (Pb) Free Program Status and RoHS

To comply with the EC deadline of July 2006, Linear Technology can currently supply Lead-Free Matte Tin terminal plated products, upon customer request, on all Plastic Packages ([Excluding Hermetic Packages](#)) under Special Flows #PBF in bulk pack (canisters or PVC tubes), or #TRPBF in Tape and Reel. Devices with Lead Free terminal plating will have the same basic part numbers with the suffix #PBF or #TRPBF on the container labels. Although Matte Tin will become LTC's standard terminal finish, solder plated products will continue to be available for the foreseeable future.

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\* [RoHS Material Declaration Certificate](#)

\* [Sony Green Partnership Certificate](#)

\* [ISO14001 Certificate](#)

\* [EU Directive 2002/95/EC](#)

#### Selection of Matte Tin as a Lead (Pb) Free Alternative

Even though LTC has evaluated other Lead (Pb) Free alternatives (e.g., Palladium Nickel Gold) a decision was made to use Matte Tin for the following reasons. Matte Tin represents the best drop-in replacement since it is the most cost effective solution, has a lower reflow temperature ~240°C, is compatible with reflow soldering processes using PbSn and SnAgCu solder pastes, has excellent solderability performance, and based on LTC's extensive qualification/reliability testing has excellent reliability performance.

[Matte Tin Reliability Data](#)

[Matte Tin Surface Mount Evaluation Results](#) (6.6MB)

**Conversion Plan**

In order to comply with the EC deadline of July 2006, LTC will convert to Matte Tin as standard terminal finish by the end of 2005. This conversion will be carried out on a package-by-package basis. Although Matte Tin will become LTC's standard terminal finish, solder plated products will continue to be available for the foreseeable future. Currently Linear Technology can supply Matte Tin terminal plated products, upon customer request, on all plastic packages under Special Flows #PBF, or #TRPBF in Tape and Reel.

**Ordering Lead (Pb) Free Parts**

A Lead (Pb) Free Product can be ordered by adding suffix #PBF to the standard LTC part number. This suffix is included in the Lead (Pb) Free part number.

**Example 1:** To order a standard part in shipping tubes or canister (TSOT, SC70, 2x2 DFN) with a Lead (Pb) Free lead finish:

<u>Standard Solder Plated Part</u>	<u>Lead (Pb) Free Part</u>
LT1016CS8	LT1016CS8#PBF
LT1937ES5	LT1937ES5#PBF

**Example 2:** To order a standard part in tape and reel with a Lead (Pb) Free lead finish:

<u>Standard Solder Plated Part</u>	<u>Lead (Pb) Free Part</u>
LT1016CS8#TR	LT1016CS8#TRPBF

**Example 3:** To order a standard part with a Special Flow XX with a Lead (Pb) Free lead finish:

<u>Standard Solder Plated Part</u>	<u>Lead (Pb) Free Part</u>
LT1016CS8#XX	LT1016CS8#XXPBF

The full Lead (Pb) Free part number will also be marked on the container labels.

**Ordering Lead (Pb) Free Samples**

Contact the nearest [LTC Sales Office](#) to order Lead (Pb) Free samples.

**Lead (Pb) Free Marking**

JEDEC Standard JESD97 defines various Lead (Pb) Free categories with symbols e1 through e7. The symbol e3 applies to products with a Matte Tin (Sn) terminal finish. Since LTC Lead (Pb) Free products have a Matte Tin (Sn) terminal finish, the symbol e3 is added to the product top marking of larger packages, where space permits. On packages that are too small to accommodate the e3, a "<" symbol is added to the device at the pin 1 location. Lead (Pb) free 2mmX2mm and 3mm X 2mm packages is identified by rearranging the trace code marking of the device. These Lead (Pb) Free marking indicators were implemented starting with datecode 0514. However, we will continue to ship Lead-Free product, from our existing stock, which was marked prior to 0514 without the indicator.

**Photograph of Pb Free Marking (2.39MB)****Table of Pb Free Indicator Location**

The e3 is marked on the same line as the date code or the trace code. There is no change to the line that contains the part number. This is a change to the top marking to better identify Lead (Pb) Free products and does not reflect any change to the form, fit or function of the products.

**Electrical Performance and Datasheets**

There is no difference in the electrical performance of the Pb Free devices compared to the original devices with solder plated terminal finish. Therefore, LTC will not need to issue new datasheets for Pb Free devices.

**Recommended Lead (Pb) Free Reflow Profile**

Matte Tin terminal finish can be soldered very well at 240°C to 250°C and does not require soldering above 250°C. Matte Tin terminal finish is backward and forward compatible with SnPb and SnAgCu solder paste. The soldering profile should conform to LTC's recommended procedures for Surface Mount Products.

[Surface Mount Products Soldering Conditions](#)

[Future Higher Temperature Mold Compound](#)

#### **Products with Lead (Pb) Containing Die-Attach Solder**

LTC builds a variety of packages, e.g., TO-220, SOT-223, DD Pak, etc. that use a lead (Pb) containing die-attach solder. This solder is exempt from current legislation due to the lack of a suitable replacement material, as defined in Article 4 of the [EU Directive 2002/95/EC](#), Annex--section 7 (>85% lead, Pb, in high temperature melting point solders).

#### **Conversion Notification**

LTC will notify customers prior to converting to a Lead (Pb) Free terminal plating as LTC's standard plating, including the schedule for the conversion.

#### **Availability of Solder Plated Products in the Future**

LTC is fully aware that some customers, particularly those in the military, networking, and telecommunication industries, have concerns over the conversion to a Matte Tin (Sn) terminal finish. Since many of their products are exempt from current legislation, as defined in Article 4 of the [EU Directive 2002/95/EC](#), Annex--section 7, as follows:

- Lead in solder for servers, storage and storage array systems (exemption granted until 2010),
- Lead in solder for network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunications. Many of these customers can continue to accept product with a solder plated terminal finish. LTC plans to continue to offer products with a solder plated terminal finish to these customers for the foreseeable future.

#### **Summary of Matte Tin Qualification Data**

[Matte Tin Reliability Data](#)

[MSL Rating by Package Type](#)

#### **Summary of Board Level Surface Mount Evaluation Results**

[Matte Tin Surface Mount Evaluation Results](#) (6.6MB)

#### **Mitigation of Tin Whisker Growth**

LTC has conducted extensive long-term storage tests, namely 85°C/85%RH temperature/humidity testing and ~50°C/~60%RH storage testing, and has found LTC's Matte Tin terminal finish to be reliable, with whisker growth less than the industry acceptable size of 30 to 50 microns. The 50°C/60%RH long-term storage test has been conducted on some packages for close to 5 years with acceptable results.

In addition to excellent reliability test results, LTC has implemented the following to further mitigate Tin Whisker Growth:

- \* Maintain a minimum of 300 micron tin-plating thickness (target 450 microns).
- \* Minimize organic brighteners in tin-plating bath.
- \* Plating anneal of 150°C for 1 hour immediately following the plating process. This anneal reduces stresses and promotes a more uniform growth of intermetallics.

#### **Mold Compound Change for Higher Soldering Temperature Performance**

LTC is in the process of completing qualification on new mold compounds that do not incorporate bromine and antimony trioxide as fire retardants. The new mold compounds will also improve the [MSL Rating](#) based on the higher 255°C, +5, -0°C reflow soldering tests. LTC is scheduled to finish this qualification and make the conversion during the first half of CY2005. As soon as the reliability qualification testing is completed, additional data will be posted on LTC's website.

Note: LTC has never used mold compounds containing [Red Phosphorus](#), nor will we use them on these upcoming changes.

#### **Hermetic Packages Excluded from Lead (Pb) Free**

Please be advised that Linear Technology is not currently offering Pb Free terminal finish on D, H, J, K and W hermetic packages. There is not enough demand for the Pb Free terminal finish on these packages to justify the dedication of resources to develop Pb Free terminal finish. At this point, we are not positioned to support small orders for these packages. However, any major business opportunities should be discussed with a Linear Technology Sales Representative to explore the Pb Free alternatives.

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