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# TND312/D

# Matte Tin Plating for Pb-Free Devices Backward Compatibility to Tin-Lead Solders

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**APPLICATION NOTE**

With the deadline dates for RoHS and WEEE Directives out of Europe looming mid 2006, many component suppliers are faced with the challenge of qualifying their products. Both directives address the issue of eliminating Pb from components that will be used in the environment. Semiconductor companies must choose a Pb−free plating strategy that will be cost effective, backwards compatible with Pb containing solders and forwards compatible with Pb−free solders.

Backward compatibility to tin−lead processes is considered to be critical for this transition from tin−lead to Pb−free processes. During the Pb−free transition many component suppliers may mount SnPb plated parts with Pb−free plated parts onto the same board. Therefore, customers may be using SnPb reflow profiles with Pb containing solders on their PC boards to mount their Pb−free packages. Component suppliers must anticipate this issue in their selection of plating finishes for Pb−free devices.

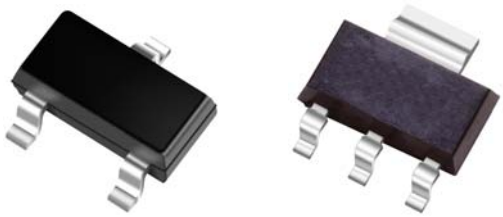
ON Semiconductor has selected pure matte tin plating as their choice for Pb−free component finish for lead frame type packages. Matte tin plating as a lead finish has a long history in the industry and has proven to be reliable and very comparable with tin−lead solders for board mounting. ON Semiconductor Pb−free products are fully backward compatible with SnPb reflow processing, with the exception of BGA/Bumped die/Flip−Chip devices. This article will present ON data and industry references supporting matte Sn backward−compatibility with tin−lead soldering processes.

## Evaluation

Test Methods Used:

| | **Criteria** |
|---|---|
| Dip and Look | 95% Coverage |
| Cross−Sections after Board Mount | Wetting Coverage along Lead |

Two lead frame packages were chosen for this evaluation: the SOT23 and the SOT223. Both package types are shown below. Both packages were plated with 5−7 microns of matte tin plating. Control samples plated with 5−6 μm of 63/37 SnPb were also tested for comparison.



**SOT23** **SOT223**

**Figure 1. Lead Frame Packages**

**TEST METHOD: Dip and Look Test**

Parts were dipped into a solder pot containing 63/37 SnPb solder at 210°C for three seconds. Note, 210°C was chosen, since it is considered by ON and other industry leaders as the minimum reflow peak temperature for tin plated parts (1, 2). Wetting of the SnPb solder paste to the matte Sn lead finish was acceptable in all tests for reflow temperatures of 210°C and above. Typical wetting can be seen in examples shown in Figures 2 and 3. Since low reflow temperatures would be more prone to exhibit any dewetting phenomena, only the minimum temperature solder wetting data is provided in this note.

**Matte Tin** **Tin−Lead**

NOTE: 95% coverage was observed for both the matte tin and tin−lead plated packages.

**Figure 2. SnPb Solder Wetting to SOT23 Package Leads at 210°C**



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Matte Tin SnPb

NOTE: 95% coverage was observed for both the matte tin and tin−lead plated packages.

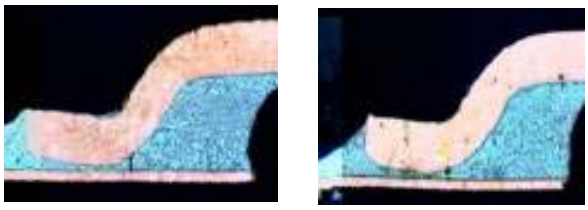
**Figure 3. SnPb Solder Wetting to SOT223 Package Leads at 210°C**

### TEST METHOD: Cross−Sections

The packages were mounted onto PCB boards and reflowed at 210°C and visually checked for fillet formation and wettability. Cross−sections were performed to verify solder joints. All parts tested exhibited good fillet formation with SnPb solder for temperatures of 210°C and above as can be seen in examples shown in Figures 4 and 5. Only the minimum temperature solder wetting data is provided in this note.

Matte Sn Plated SnPb Plated

**Figure 4. Cross−Section of SOT23 at 210°C**



Matte Sn Plated SnPb Plated

**Figure 5. Cross−Section of SOT223 at 210°C**

### BGA Packages/Bumped Die

Backward compatibility recommendations in this note do not extend to Pb−free bump (ie; SnAgCu) terminations found on Flip−Chip or BGA products. It is recommended that only Pb−free solder pastes and reflow profiles be used with these Pb−free products.

## Summary

The purpose of this note was to verify backward compatibility. The key points to conclude are as follows.

- The dip and look test shows that pure matte Sn is comparable to SnPb plating at minimum reflow temperature of 210°C or above.
- 95% coverage was seen on all leads for the dip and look test for both matte Sn and tin−leaded components.
- Cross−sections comparing pure matte Sn plating and SnPb plated packages at 210°C do not show any significant differences in solder fillets.
- BGA packages and bumped−die packages that use SnAgCu terminations for Pb−free application must use a Pb–free reflow temperature profiles. Using SnPb reflow profiles will result in unreliable solder connections.

ON Semiconductor Pb−free products are fully backward compatible with SnPb reflow processing, with the exception of BGA/Bumped die/Flip−Chip devices.

## References


1. “Soldering Compatibility (Backward and Forward)”, STMicroelectronics Inc., Application Note AN2034, November 2004.
2. Ing. J.M. Scheer, “Alpha Run on SnPb and Sn Plated SMD Components”, Philips Electronics, Electronic Packaging and Assembly, July 2002.
3. N. Vo, Y. Nadaira, T. Matsura, M. Tsuriya, R. Kangas, J. Conrad, B. Sundram, K. Lee, S. Arunsalam, “Pb−free Plating for Peripheral/ Lead frame Packages,” IEEE, Elec. Components Conf., 2001: pp. 213−218.
4. JEDEC Solid State Technology Association (Once known as the Joint Electron Device Engineering Council) (http://www.jedec.org).





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