Mini-Circuits®

Application Note
(AN-00-004)

MINI-CIRCUITS AD FAMILY

CUSTOMER SOLDERING
OF
MATTE TIN PLATING

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1.0 Introduction:

The electronics industry has been undergoing dramatic change as a result of environmental concerns over the use of lead (Pb) in component finishes. The availability of alternative platings is limited by specific requirements of leadframe manufacturers.

One popular finish, 100% matte tin over nickel barrier, is attractive because of availability of mass processing, excellent solderability and shelf life. The use of 100% tin, however, is questioned by some users because of the phenomenon known as Tin Whiskering.

While extensive tests for storage, humidity and thermal cycles are being done, no one really understands the ideopathy of this condition. What is known, however, is that encapsulation and fusing can inhibit whisker growth by altering the stresses and grain structure of 100% tin. Mitigation of whiskers is also accomplished by use of a nickel barrier.

Mini-Circuits' lead-free AD type package is inherently whisker free because of its geometry, the nature of the solder encapsulation, and the limited area of exposed matte tin. The exposed area of the lead before reflow soldering is at most 0.03 by 0.03 inches (see fig. 4). The leads themselves are almost totally covered by solder during the customers reflow solder process (see fig. 3). The small size and embedded nature of the leads makes this package virtually leadless.

AD Family Application:

For many years, Mini-Circuits has offered the AD Type package of Mixers, Splitters, Couplers and Transformers as a highly reliable and reasonably priced component. The patented design incorporates embedded leads in a thermoplastic header. (See fig. 1) All internal wire connections are welded. No solder is used.

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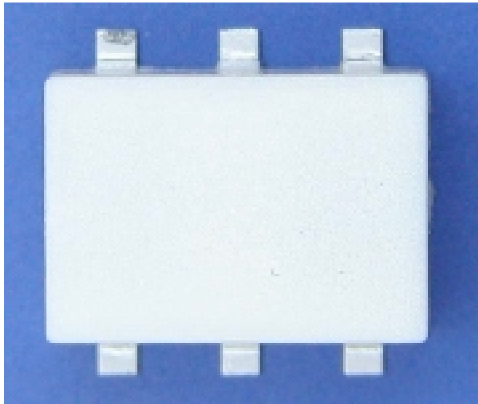
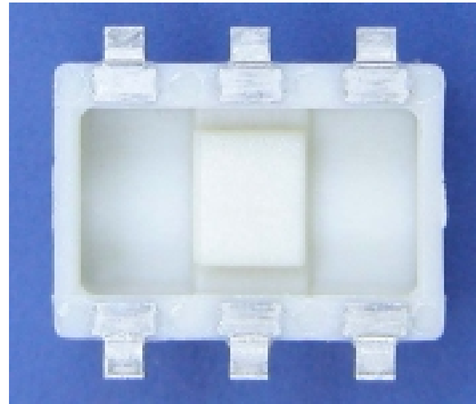
Fig. 1
B12-30-33+ (Q#0420151)


Top View


Bottom View

The lead plating process has been tin/lead over nickel barrier. As a result of the environmental standards placed on the electronic industry (EU RoHS, WEEE and Japanese Standard), Mini-Circuits has qualified 100% matte tin over nickel barrier as a suitable, compliant leadframe finish to replace the tin/lead over nickel barrier. (Ref. Document No. D4-QR-CD-3 Qualification Report of Lead Free Header B12-30-34+)

What About Whiskers?:

In addition to incorporating mitigations into the design, the case style itself is whisker resistant because of the way customer solder will reflow around the lead.

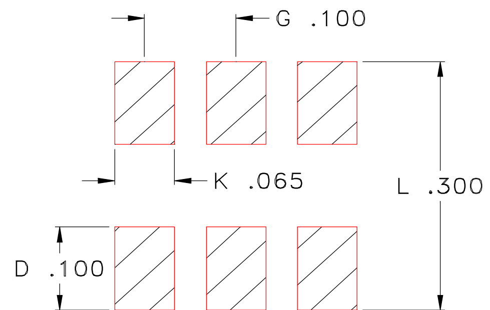


Fig. 2

When using the recommended footprint (See fig. 2) and appropriate aperture and thickness of stencil (6-7 mil), the unit can be expected to reflow according to that seen in figure 3. By using eutectic (SnPb) or Pb-free solder paste (SnCuAg), the 100% Matte Tin of the leadframe is fused and

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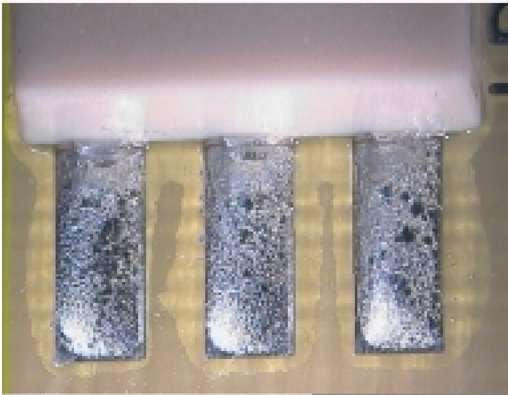
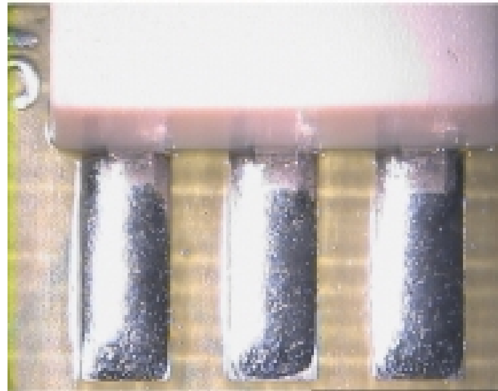
encapsulated. The amount of leadframe exposed after reflow soldering is insignificant,
cutting off any attraction of whisker growth that may be expected in between the leads.

Fig. 3
B12-30-34-Q+
Reflowed Units (34.0 x Magnification)

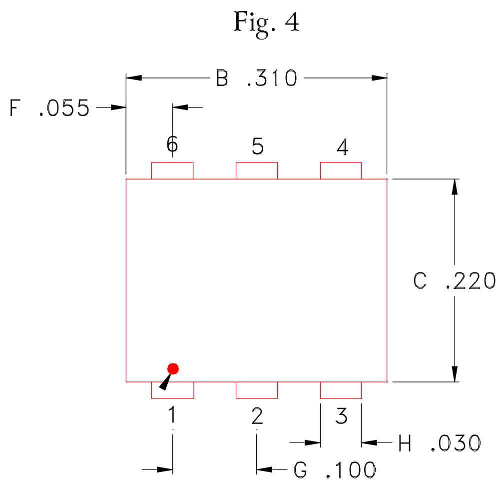




Sample #1
Lead Free Solder

Sample #2
63 / 37: Sn/Pb Solder

Fig. 4



The distance between the leads, 0.07 inch, provides further protection against whisker damage (see Fig. 4). Since whiskers are typically measured in microinches, there is ample gap between the leads to prevent any shorting.

Fusing, or stress relieving by heating is also a recognized mitigation technique. In the case of AD packages, the internal Mini-Circuits process calls for heat curing at 125°C for one half-hour. This, in addition to the reflow carried out by the customer, will stabilize any stresses in the plating.

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The units in the Appendix were solder stencilled and reflowed on bare ceramic. This enabled us to view the encapsulation of the 100% Matte Tin leadframe in tin/lead solder

Conclusion:

Mini-Circuits' patented AD family of package components has been qualified and are guaranteed against whisker growth damage in electronic circuits.

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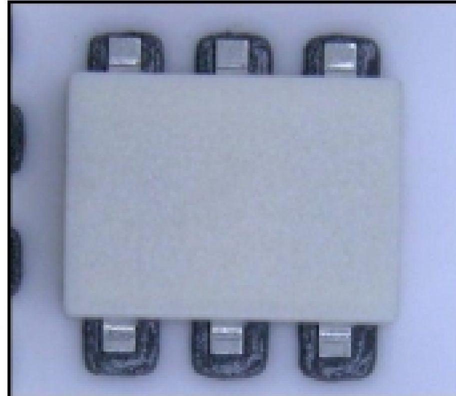
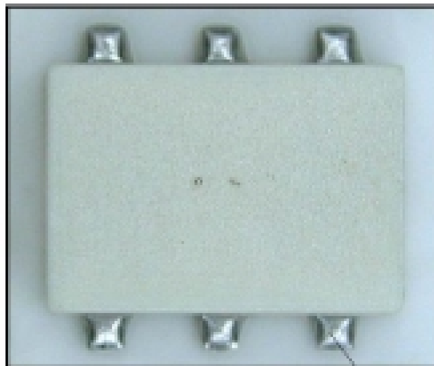
APPENDIX

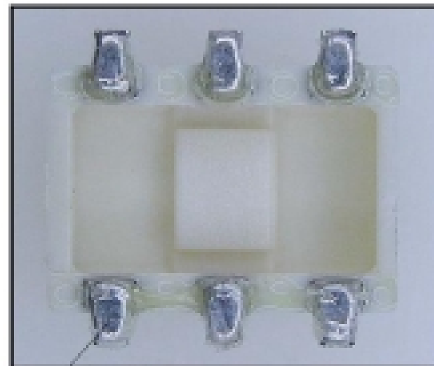
Solder Paste Deposit & Component Placement on Ceramic Plate



EUTETIC Sn/Pb SOLDER DEPOSIT ADE PLACED

Top & Bottom view of ADE Model after Soldering





TOP VIEW LEADS W/SOLDER BOTTOM VIEW

Magnified view of the Lead

TOP VIEW - LEADS W/SOLDER

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