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APPLICATION NOTE 2004-01

# Lead-free BGA Sockets Designed to Meet High Temperature Processing Requirements Offer Additional Design Benefits

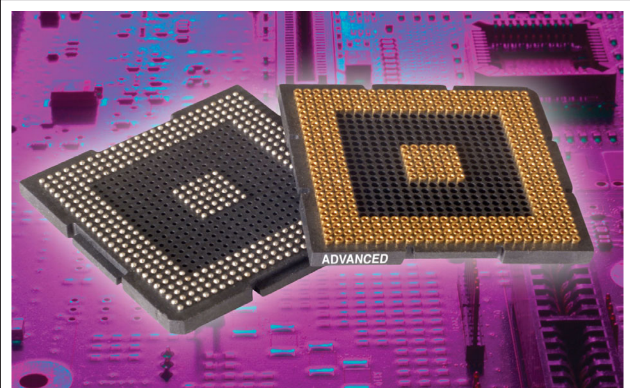
## THE CHALLENGE

As the electronics industry moves toward lead-free manufacturing to comply with the Restriction of Hazardous Substances (RoHS) Directive and other worldwide initiatives for environmentally-friendly manufacturing, component manufacturers must offer viable solutions to their customers. Until the new requirements are fully implemented, the industry will need components that conform to both existing solder reflow profiles and the newer high-temperature profiles required for effective processing of lead-free components.

Over the past decade, semiconductor manufacturers have relied on Ball Grid Array (BGA) packaging for improved interconnect yields. BGA devices and mating sockets have been used effectively in thousands of applications, specified in large part due to the superior processing results achieved with the industry-standard 63Sn/37Pb eutectic solder ball. Finding a suitable substitute for lead in solder ball terminations without impacting yield performance, is an industry-wide challenge.

Advanced Interconnections (AIC) has worked with leading semiconductor manufacturers and electronic OEMs to select a new solder ball material that will yield results consistent with the tried-and-true 63Sn/37Pb eutectic solder ball. As new lead-free products are introduced, additional product enhancements will be designed-in to offer benefits beyond just lead-free process compatibility.

## THE ADVANCED® SOLUTION




*Lead-free BGA Sockets, precision molded from liquid crystal polymer (LCP), offer benefits beyond high temperature processing compatibility.*

AIC selected a tin/silver/copper (SnAgCu) alloy with a reflow temperature of 218°C (424° F) for its new lead-free solder ball material. The first product offering to incorporate these lead-free solder ball terminals is a line of 1.00mm pitch BGA Sockets in precision molded LCP wafers. Molded from high temperature, glass filled thermoplastic, the new sockets are able to withstand the higher processing temperatures required in lead-free processing [up to 276° C (528° F)], and are available in both surface mount and thru-hole designs.

Additional benefits of the new molded design vs. its FR-4 predecessor include improved hole-to-hole accuracy and reduced insertion and withdrawal forces. Full grid wafers are pin loaded to the exact footprint specified and are available in any footprint-specific pattern to accommodate a BGA, LGA, or CSP device.

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As mentioned above, one of the biggest challenges when implementing a lead-free manufacturing process, is taking into account the higher processing temperatures required to process components with lead-free solder balls. With peak processing temperatures climbing 20° to 35° C, virtually every component and the board itself must be requalified.

A generic lead-free solder reflow profile is provided below as a guideline when using our products that feature the new Sn/Ag/Cu solder balls. Actual solder process requirements will be determined by the customer based on the specific application.

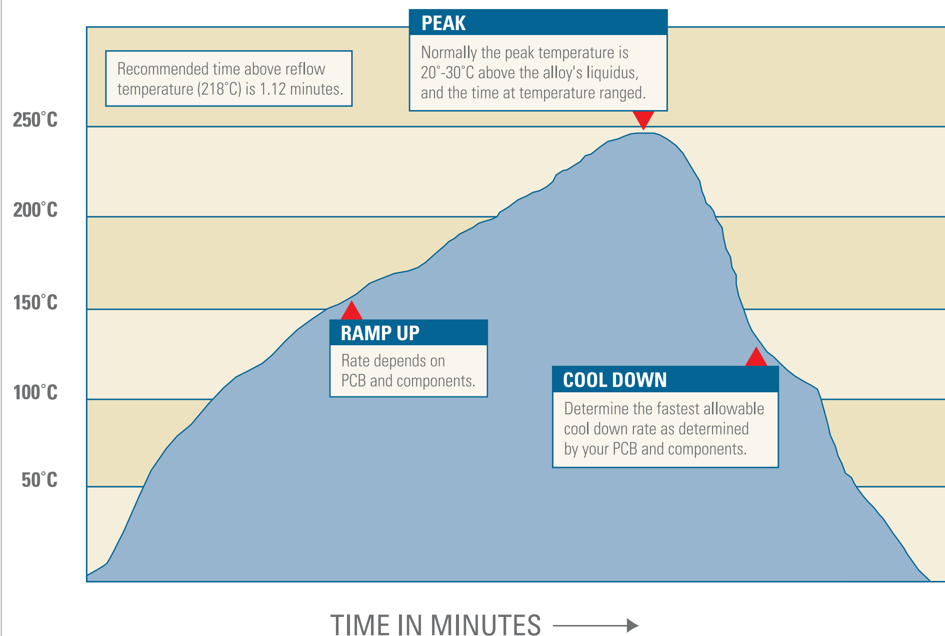
As manufacturing processes are established, issues such as backward and forward compatibility, maintaining quality, requalifying designs, etc. are critical to a successful transition. AIC is committed to working with design and manufacturing engineers throughout the transition to lead-free manufacturing, offering application assistance as well as innovative standard and custom interconnect solutions. We will continue to offer our industry-proven eutectic solder ball products along with new lead-free products until the transition is complete worldwide.

**1. Solder Paste Deposition**
- Solder paste should be selected based on application requirements.
- The recommended solder volume is 0.0016 - 0.0032 cubic inches (0.040 - 0.080 cubic mm) with a pad diameter of 0.020 - 0.028 inches (0.51 - 0.71mm).

**2. Solder Reflow**
- See profile.

**3. Inspection and Testing**
- Initial visual inspection for positioning of solder ball to pad along perimeter is recommended to verify reflow of balls.
- Secondary X-Ray tests for overall continuity verification are recommended.
- For production applications, electrical MDA (Mfg. Defects Analysis) tests are recommended.

## Generic Lead-free Reflow Profile
### Sn/Ag/Cu Solder Liquidus at 218˚C (424˚F)




*Solder process recommendation is presented for guidance only. Factors such as different board sizes, densities, and equipment will change actual solder process requirments. Example presented should be used as a starting point only - actual solder process specifications should be developed based on individual requirments and capabilities.*

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