COTS Watch

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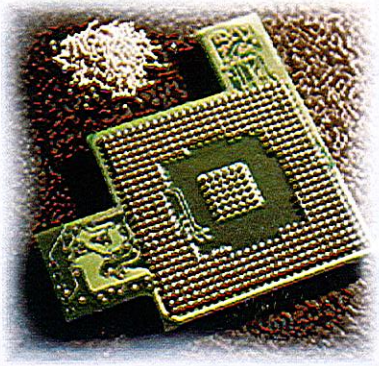
ROLLING RUGGED BGAS BY REBALLING

Leaded solder became an endangered species with the European Union's Restriction of Hazardous Substances (RoHS) legislation in 2006. Since that time, military electronics specifiers opting for commercial-off-the-shelf (COTS) components have watched as products with lead-containing solder have faded from the marketplace, without replacements. This can pose a problem for program managers trying to maintain strong COTS content in their systems. Fortunately, there are some alternatives when a ball-grid-array (BGA) component (see figure) is not available manufactured with tin-lead alloy.

One option is the choice of a mixed-alloy system in which leaded solder is used to attach lead-free solder-balled components to "off-the-shelf" parts. The mixed-alloy approach does pose some problems since circuit boards must be processed at higher temperatures to reflow the lead-free solder balls. This can impact the integrity of existing printed-circuit boards (PCBs) and their components, requiring a battery of reliability tests.

Another option is to use RoHS-compliant parts and lead-free solder and institute a new qualification and reliability testing process for these parts. A further option is to remove the "lead-free" solder balls from a COTS component and "reball" the component using Sn63Pb37 solder balls, then assemble the PCB using the proven soldering system. This reballing process is being performed on a variety of military components out of both expediency and economic necessity.

While there are a number of methods for each step of the reballing process, some basic elements are common to all of them. After incoming inspection of components, plastic bodied components are dry baked in accordance with their moisture sensitivity level (MSL).[1] The next step is the reballing or removal of the solder balls. This can be accomplished using tools from an automated dynamic wave soldering process to a simple solder wicking operation depending on the quantity and type of package being reballed. After site cleaning and dressing, new solder balls are attached to the device by means of a manual preform method for low-volume production and fully automated process for high-volume production. The part and replacement solder balls are now sent through a heat source where the solder is reflowed and then attached to the pads on the component. Finally, the reballed parts are cleaned, inspected, baked, and properly repackaged.



Reballing is a practical approach for remanufacturing COTS components for military applications that require parts with tin-lead alloy.

A number of studies have been performed that confirm that the reliability of a reballed device does not differ statistically from the original. One study pointed out that while the intermetallic thickness is lessened after a number of reballing cycles, the ball shear strength for as many as five reballing cycles is not impacted.[2] Another recent study concluded that the die of the BGA is not impacted from a reliability standpoint even after as many as nine reballing cycles.[3] Another study concluded that a reballed devices' reliability is not impacted by multiple reballing cycles.[4] While published data suggests that reballed devices are perfectly acceptable in terms of their long-term performance, users are always recommended to take appropriate action to confirm reliability based on the demands of the actual operating environment.

Since the advent of the RoHS guidelines, the supply of tin-lead balled BGAs has evaporated, forcing high-reliability customers to develop a strategy for finding replacements. The most cost-effective solution is the reattachment of tin-lead solder balls to a RoHS component. While this is a reversal of COTs strategy, qualification testing assures users that this is viable solution.

REFERENCES

1. Guidelines for handling MSD devices as set forth in IPC J-STD 033.
2. Nie, Lie et al. (2007) "Solder Ball Attachment Assessment of Reballed Plastic Grid Array Packages," Symposium Proceedings on Printed Wiring Assembly Rework/Repair and Part Reprocessing.
3. Ray Cirimele, "BGA Reballing Reliability," Symposium on Reprocessing Tin Whisker Mitigation, and Assembly Rework, 2008.
4. Daryl Santos et al. (2000), "Evaluating the Mechanical Reliability of Reballed BGA Modules," Proceedings of SMTAI International, pp. 456-474.