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Improved Ball Grid Array Solder Joints

ABSTRACT

This disclosure describes techniques for mitigation of warpage and improvement of soldering yield and solder joint shape consistency in ball grid arrays (BGAs) in printed circuit board assembly (PCBA) process. An added free weight is placed on the BGA package before it enters a solder reflow process. Standoffs are provided on the surface of the PCB. To prevent damage to the die and/or internal structure of the package, a suitable weight is selected. A support fixture is provided at the base to prevent the PCB from sagging due to the extra weight. Solder joint formation can be adjusted by adjusting the height of the spacer and/or the applied solder paste volume. Techniques of this disclosure can be applied to a rigid and/or flex PCB assembly (PCBA) manufacturing process.

KEYWORDS

- Ball grid array (BGA)
- Warpage
- Solder reflow
- Solder joint
- Joint reliability
- Surface-mount technology (SMT)
- Printed circuit board (PCB)

BACKGROUND

Surface mount technology is commonly utilized to mount electronic components onto printed circuit boards (PCBs). In this method, solder pads are provided on a surface of a PCB, to which solder paste is applied. Components such as microprocessors can utilize a ball grid array (BGA) package that includes solder balls at the bottom of the package. Pick and place machines can place the BGA package onto the PCB such that the solder balls on the BGA package line up with the solder pads on the PCB surface. A reflow soldering process is utilized to bond the components to the PCB, wherein the PCB enters a high temperature zone (e.g., a reflow oven) that melts the solder particles in the solder paste. Depending on the solder alloys used for the solder balls on BGA and/or solder paste, solder balls on the BGA may or may not melt. When the PCB cools, a soldered connection is formed between the component (package) and the PCB.

The soldering yield and long-term reliability of solder joints can be negatively affected by warpage of the BGA and PCB at the high temperatures encountered during the reflow process as well as in operation. The warpage induced solder joint shape inconsistency can also negatively affect signal integrity (SI) performance, which is critical to high-speed chips.

DESCRIPTION

This disclosure describes techniques for mitigation of warpage and improvement of solder joint consistency in ball grid arrays (BGAs) in printed circuit board assembly (PCBA) process. Per techniques of this disclosure, during the solder reflow process that is utilized to bond the BGA package to the PCB, a free weight is placed on the BGA package to minimize BGA and PCB warpage. Additionally, spacers are provided on the PCB surface to improve solder joint consistency.

Techniques of this disclosure can be particularly beneficial where the BGA size and structure complexity is high and where the electronic components are designed for high-speed signal applications that require high solder joint shape consistency.

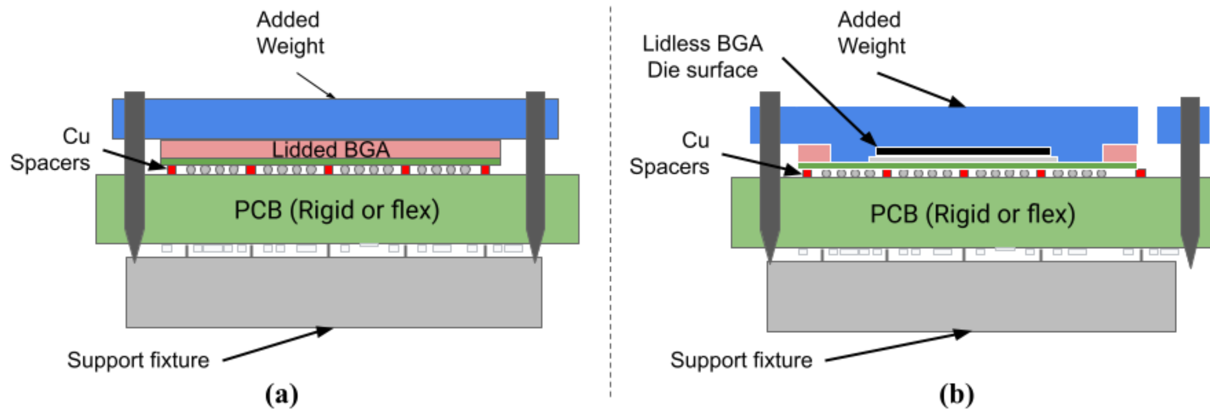

Fig. 1: Added weights and standoffs are utilized during a solder reflow process

Fig. 1 illustrates an example of the use of added weights and standoffs during a solder reflow process, per techniques of this disclosure. Fig. 1(a) depicts a lidded BGA package and Fig. 1(b) depicts a lidless BGA package.

As depicted in Fig. 1, an added free weight is placed on the BGA package before it enters a solder reflow process. Standoffs (e.g., copper spacers) are provided in a distributed manner on the surface of the PCB. To prevent damage to the die and/or internal structure of the package, a suitable weight is selected. It is a free weight such that it does not mechanically constrain the package from movement or expansion during reflow. A support fixture is provided at the base to prevent the PCB from sagging due to the extra weight.

As depicted in Fig. 1(a) the free weight is placed on top of the lid for a lidded BGA package. For a lidless BGA package, the weight can be placed such that it rests on the die surface, as shown in Fig. 1(b). The size and shape of the free weight can be configured such that

the free weight can either rest only on the die surface, only on a stiffener ring, or a combination of die, stiffener ring, and substrate surface. Solder joint formation can be adjusted by adjusting the height of the copper spacer and/or the applied solder paste volume.

Techniques of this disclosure enable more uniform solder joint formation, thereby eliminating a process of determining an amount of solder paste to be utilized in different portions of the BGA footprint to compensate for predicted warpage. Solder bridge and head-in-pillow (HiP) joint defects can also be mitigated while promoting signal integrity (SI) performance consistency. Techniques of this disclosure can be applied to a rigid and/or flex printed circuit board assembly (PCBA) manufacturing process.

CONCLUSION

This disclosure describes techniques for mitigation of warpage and improvement of soldering yield and solder joint shape consistency in ball grid arrays (BGAs) in printed circuit board assembly (PCBA) process. An added free weight is placed on the BGA package before it enters a solder reflow process. Standoffs are provided on the surface of the PCB. To prevent damage to the die and/or internal structure of the package, a suitable weight is selected. It is a free weight such that it does not mechanically constrain the package from movement or expansion during reflow. A support fixture is provided at the base to prevent the PCB from sagging due to the extra weight. Solder joint formation can be adjusted by adjusting the height of the spacer and/or the applied solder paste volume. Techniques of this disclosure can be applied to a rigid and/or flex PCB assembly (PCBA) manufacturing process.