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How to rework underfilled BGA

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Anotace:
A Ball Grid Array (BGA) component has become one of the most popular packaging alternatives for high density integrated electronics devices. BGA packages become smaller and electrical equipment has become lighter, therefore such equipment is more sensitive to mechanical stress. Therefore the underfill of the chips is used to improve the lifetime and reliability of electronic equipment. On the other hand there are issues with removing of the underfilled component from the printed circuit board (PCB) without damaging the PCB together with soldering pads. The goal of this article is to present the rework possibility of underfilled components, when a very fine milling machine was developed for the components rework purposes in LVR at CTU in Prague

Součástka s pouzdrem BGA se stala jednou z nejvíce populárních díky vysoké míře integrace. Pouzdra BGA jsou čím dál tím menší a elektronická zařízení se stávají lehčími. Díky tomu jsou taková zařízení náchylnější na mechanické namáhání. Pro zvýšení mechanické stability, spolehlivosti a životnosti zařízení se pouzdra fixují na DPS pomocí podlepení ("underfill"). Nicméně při opravě podlepených součástek hrozí nebezpečí poškození pájecích plošek u DPS. Cílem článku je představit možný způsob opravy podlepených součástek pomocí velmi jemné frézky, která byla za tímto účelem vyvinuta v laboratořích LVR na ČVUT v Praze.

INTRODUCTION

The electrical devices became smaller and lighter weight. The adoption of chip size packages (CSPs) and ball grid arrays (BGAs) enables reduction of size and weight of electronics devices [1]. The devices can be subjected to several types of stress like thermal stress (ambient temperature changes or heat generated in the chip) mechanical stress (vibrations, drop impact etc.) Smaller and lighter devices have more reliability issues; they are more sensitive to mechanical and thermal stress. Regarding to improve the reliability and life time of electronic equipment the underfill of the components is used.

Component underfill is applied on the printed circuit board (PCB) after it has been subjected to reflow. The encapsulation material is dispensed under the chip or just around the chip. The curing of dispensed material under higher temperature then follows. Underfilling of the BGA component is schematically depicted in figure 1.

Advantages of the underfill are for example: improving mechanical and thermal stability, protection against influence of ambient environment, it limits tin whisker growth, etc.

Disadvantages are additional operation in technological process and issues with removing of the underfilled component from the PCB without damaging the soldering pads on the PCB

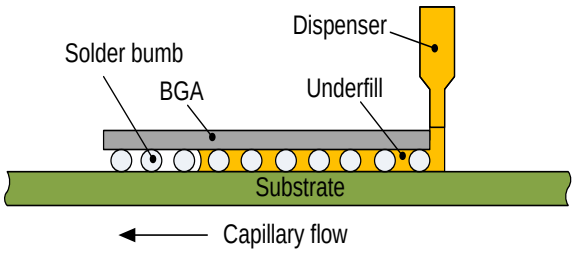

Fig. 1: Underfilling of the BGA

Many types of encapsulation materials are now available. Some of them can be removed, when they are heated to a temperature above the softening point of the underfill. Then the package is mechanically removed with enough torque which breaks the material adhesions to the board. Many encapsulation materials, e.g. epoxy based, cannot be easily removed even if they are heated. One commonly used way how to rework underfilled BGA is to heat the area around the component on the temperature above the melting temperature of the solder alloy and tried to remove it by torque force from the PCB. The soldering pads on the PCB can be damaged when the adhesion of encapsulation material to the board is to strong and thus the repair of electronic device fails.

MOTIVATION

The goal of this article is to present the rework possibility of underfilled component when a very fine milling machine was developed for the component rework purposes. Photo of this machine is depicted in figure 2. In figure 3 is a detailed photo of the PCB holder with milling tool. The software of the milling machine automatically detected the distance between the milling tool and the PCB. The milling machine removes component. The photo of the PCB with removed BGA component is depicted in figure 4.

Fig. 2: Photo of the milling machine

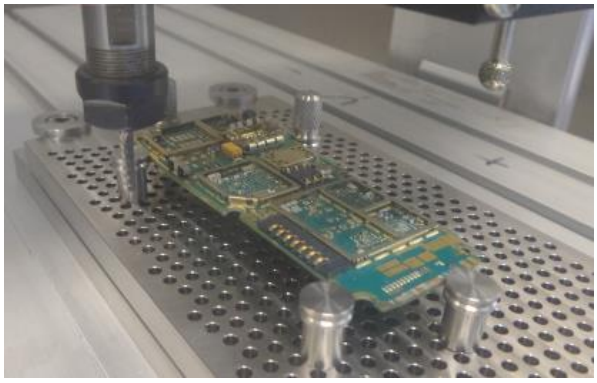

Fig. 3: Photo of the PCB holder with milling tool

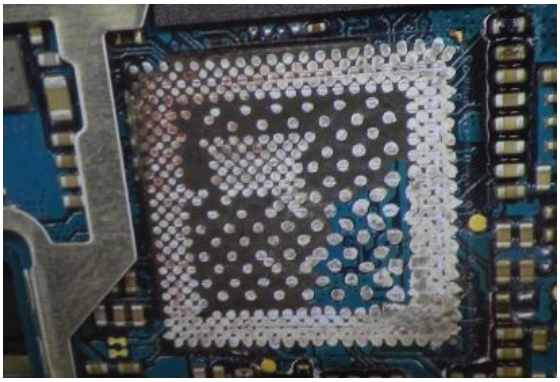

Fig. 4: Photo of the removed BGA component after milling

In figure 4, one can see mentioned residues of solder alloy and underfill. These residues have to be removed. Therefore the next step is cleaning the soldering pads, when the hot air together with jelly flux and removing tools such as tweezers and wooden stick is used. The area with removed component is heated and tweezers/wooden stick remove the residues of the undferfill. Photo of this operation is depicted in figure 5. Residues of solder alloy are then removed in a classical way, when a copper wick together with hot solder tip and jelly flux is used. This operation is depicted in figure 6. In figure 7 is depicted cleaned soldering pads on which can be mounted next BGA component.

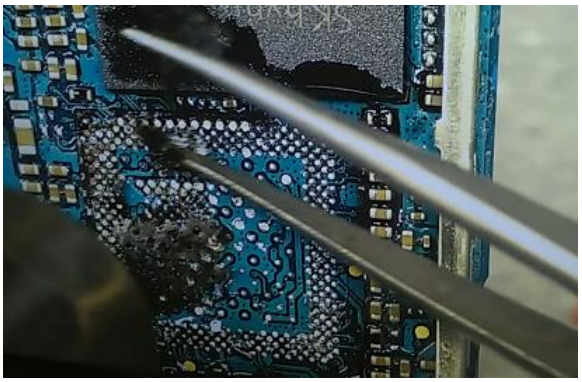

Fig. 5: Photo of removing residues of underfill by tweezers and hot air

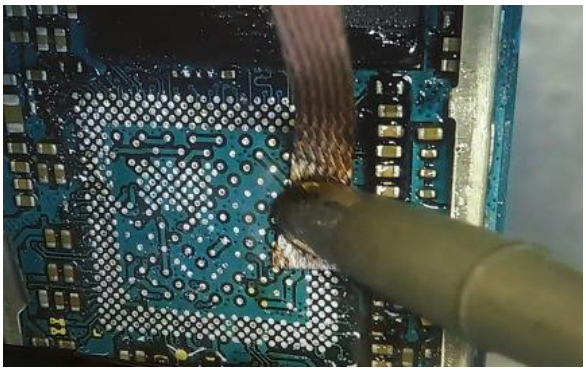

Fig. 6: Photo of cleaning of soldering pads by copper wick together with hot solder tip

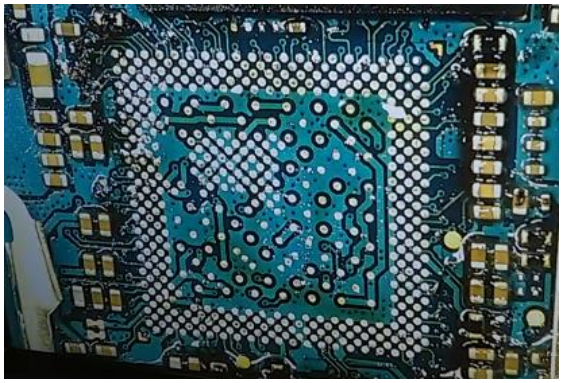

Fig. 7: Cleaned soldering pads

CONCLUSION

A possible way how to rework underfilled component was presented in this article. A fine milling machine was developed and prototype of this machine was constructed for the purposes of removing the component from the PCB. The prototype of milling machine is used in industry, when a feedback from industry confirms high success reliability of its usage during the process of removing underfilled BGA components.

One of the big advantages is that the soldering pads are not damaged and the new component can be easily soldered on them. Additional advantages are fast usage of the milling machine and money saving due to high reliability of the removing components.

A slight disadvantage of this machine is that the component is milled to a dust and therefore it is not possible to do following diagnostic of the component.

REFERENCES

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