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Package Reliability Performance Study of QFN Device on Different Die Attach Machines

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Authors' contributions

This work was carried out in collaboration amongst the authors. All authors read, reviewed and approved the final manuscript.

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ABSTRACT

The paper is focused on the reliability performance of quad-flat no-leads (QFN) package evaluated on different die attach machine platforms. Reliability tests were done to check the difference in the quality and reliability performance of the device that undergone die attach process on two different machines. Thermal cycling resulted in significant difference on the two machines, with the device processed in Machine 1 showing reliability failures while on Machine 2 it passed the 1000 thermal cycle. For future works, Machine 2 could be used for devices with critical package reliability requirement.

Keywords: Die attach process; QFN; reliability; temperature cycle.

1. INTRODUCTION

Semiconductor quad-flat no-leads (QFN) lead frame packaging technologies are continuously being developed and enhanced to provide high quality and reliable products for various applications. However, these development and breakthroughs bring along many challenges, especially in assembly manufacturing [1-3]. A common goal of semiconductor industries is to increase the production yields and maintain high quality while minimizing the wastage and

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assembly rejections. In this paper, a QFN device of tapeless leadframe technology is identified to be critical due to certain assembly issues encountered at die attach process. To simulate the real-world conditions, reliability tests are required and extensively employed on the device.

2. METHODOLOGY

The QFN device is evaluated on two different die attach machine platforms for reliability performance comparison. Machine 1 has a dispensing technology of volumetric dispense while Machine 2 has pneumatic dispensing technology wherein the volume of epoxy could be controlled through pressure. The assembly manufacturing process flow of the device in focus is illustrated in Fig. 1, highlighting the assembly process in focus. Important to note that assembly process flow changes with the product and the technology [4-7]. As mentioned earlier, new technologies and breakthroughs have corresponding challenges especially in assembly manufacturing. After the assembly of the device, the singulated units are then subjected to reliability tests.

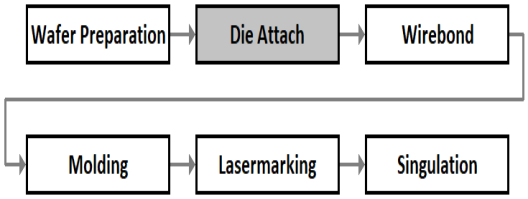

Fig. 1. Assembly process flow emphasizing the process in focus

3. RESULTS AND DISCUSSION

The reliability performance given in Table 1 has the critical parameters to consider and checks for any challenging effect of the die attach machines unto the package parameters. Both lots processed in die attach machine using Machine 1 and Machine 2 passed the moisture sensitivity level 3 (MSL3) test. Thermal or temperature cycling with 500 cycles (TC500) and 1000 cycles (TC1000) showed visible difference, with Machine 1 platform failing the test while Machine 2 passing the TC1000 reliability test. Fig. 2 shows the actual units subjected to reliability tests then measured using scanning acoustic tomography (SCAT) tool.

Table 1. Reliability performance

Experiment	Die attach machine platform	MSL3	TC1000
1	Machine 1	Passed	Failed
2	Machine 2	Passed	Passed

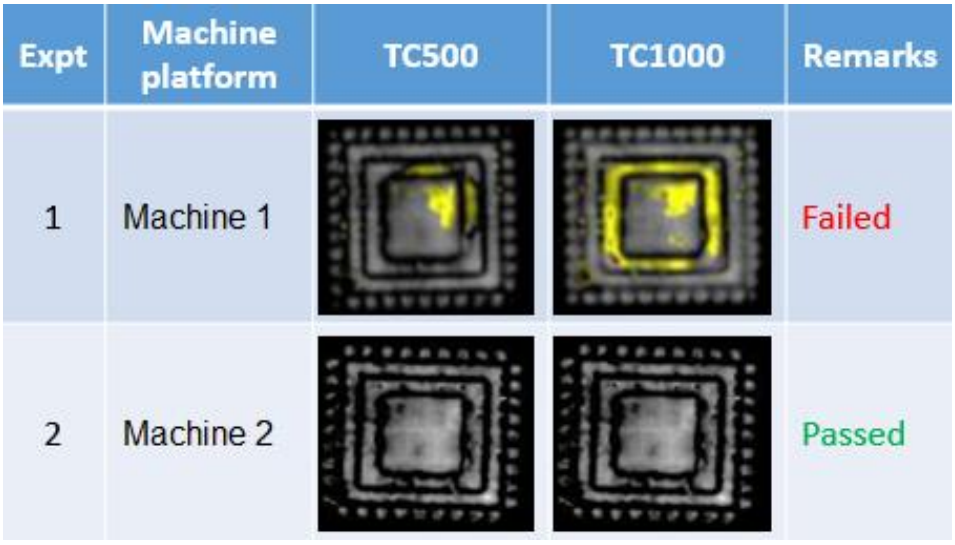

Fig. 2. Reliability test results

4. CONCLUSION AND RECOMMENDATIONS

The paper discussed the evaluation of QFN device of tapeless leadframe technology on different die attach machine platforms to check the reliability performance. In this study, the device processed in die attach Machine 2 passed both the TC500 and TC1000 reliability tests while in Machine 1 it failed both tests. For succeeding works, Machine 2 could be used on devices with stringent package reliability requirement.

Works and learnings discussed in [8-11] are helpful to improve the assembly processes focused on the die attach process. Future studies could include in-depth comparison of the die attach machines in terms of specifications and capabilities.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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