

Warpage Improvement at Wirebond Assembly Process of Semiconductor QFN Device

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I. BACKGROUND OF THE STUDY

- One of the critical issues during assembly manufacturing process of semiconductor quad flat no-leads (QFN) leadframe package or device is the warpage illustrated in Fig. 1



Fig. 1. Strip warpage representation.

- Warpage is related to the mismatch of coefficient of thermal expansion (CTE) values and reliability of the components in the package, and is normally generated in the assembly processes emphasized in Fig. 2 wherein heat is involved

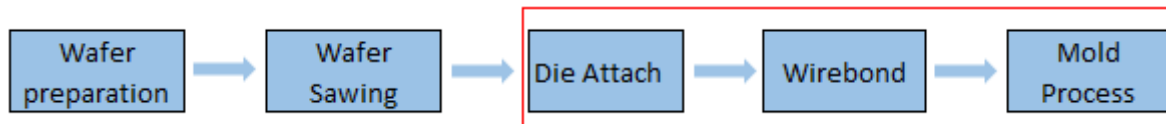


Fig. 2. Assembly processes where strip warpage is generated

- Furthermore, warpage is known to affect succeeding package assembly processes such as the package singulation or package sawing

II. PROBLEM IDENTIFICATION

- Carrier strips of the specialized 1-map QFN leadframe package after die attach curing observed a smiling warpage, and at higher wirebonding site temperature, strip warpage after wirebond process was aggravated as highlighted in Fig. 3



Fig. 3. Leadframe strip warpage after wirebond process.

- The warpage issue would eventually affect the end-of-line (EOL) processes particularly the mold encapsulation process illustrated in Fig 4, resulting to potential risk of crumpled strip during input handling in mold machine railing
- Warpage should be prevented, if not eliminated, as it would ultimately affect the package strength and reduce reliability of the final product

Strip warpage prior Mold process



Machine error defect signature:

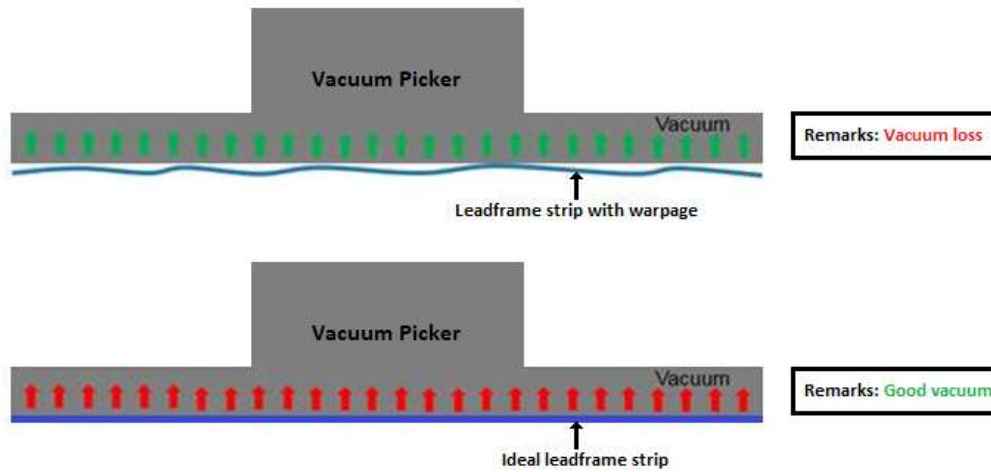


Fig. 4. Leadframe strip warpage affecting mold process.

III. MECHANICAL DESIGN SOLUTION AND PROCESS IMPROVEMENT

- The wirebond assembly process of the specific 1-map QFN leadframe device is augmented and improved with the use of a specialized design of window clamp and top plate (WCTP) given in Fig. 5



Fig. 5. Improved WCTP design for the specific semiconductor QFN leadframe device.

- With the augmented WCTP design, the warpage performance of the device has significantly improved as shown in Fig. 6



Fig. 6. Improved performance of strip warpage after wirebond process.

- The mechanical design solution includes 1 column per index to control the leadframe movement during indexing until the leadframe strip exits to the output magazine
- The improved design would also as an error-proof control for the crumpled strip during ejection or output feed