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QFN Strip Warpage Reduction through Modeling of the Impact of Package and Leadframe Thickness

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I. OVERVIEW

- A QFN (quad flat no lead) package is usually assembled in a molded leadframe array strip format as shown in Fig. 1.
- After molding at high temperature (~175 ^{o}C) and cooling down to room temperature, singulation of the individual units from the full leadframe array strip is done to isolate the individual QFN package units.

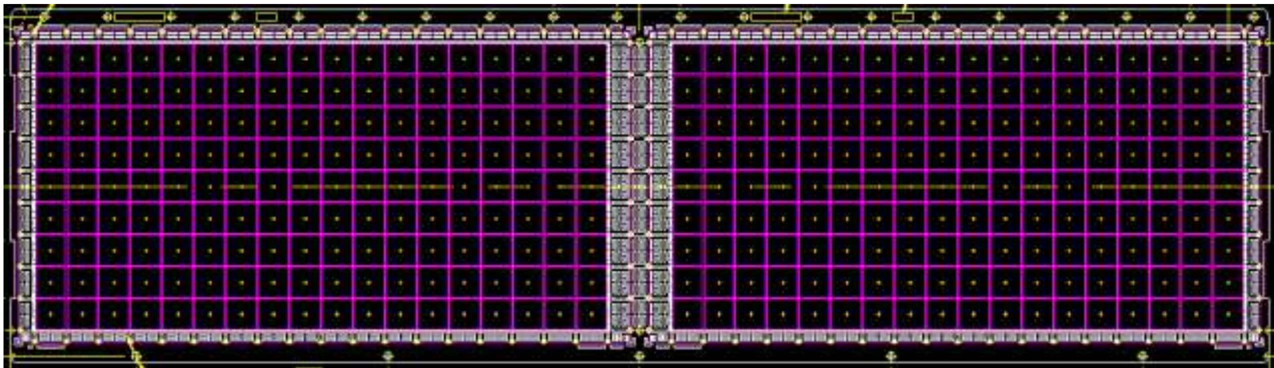

Fig. 1. QFN leadframe strip with 2 panels

II. PROBLEM IDENTIFICATION

- In one QFN package, excessive strip warpage was encountered after the transfer molding or encapsulation process.
- Instead of having a relatively flat QFN molded strip, Fig. 2 shows a very noticeable strip warpage in "frowning" mode.

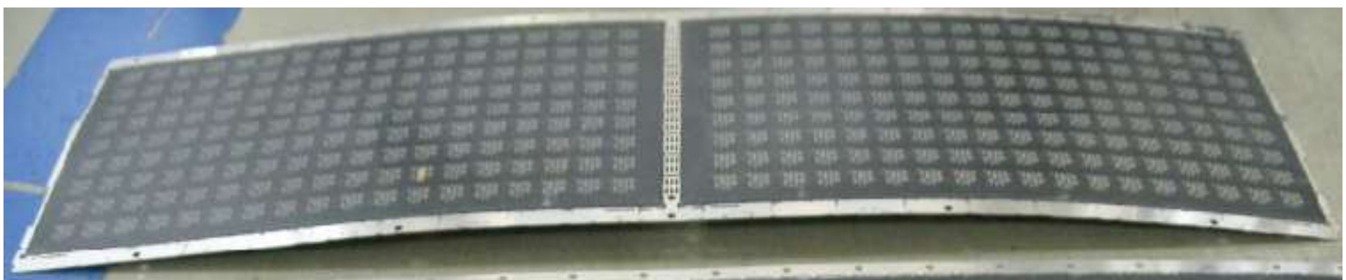

Fig. 2. Actual photo of a molded QFN leadframe strip with excessive warpage.

III. STRIP WARPAGE MODELING AND ANALYSIS

- Finite element analysis (FEA) was conducted to understand the impact of the overall package thickness as well as the leadframe thickness on strip warpage and come up with a better solution in a short period of time.
- The existing package with excessive strip warpage and two additional package options were considered as shown in Fig. 3.
- A finite element quarter model of one panel of the molded leadframe strip was analysed.

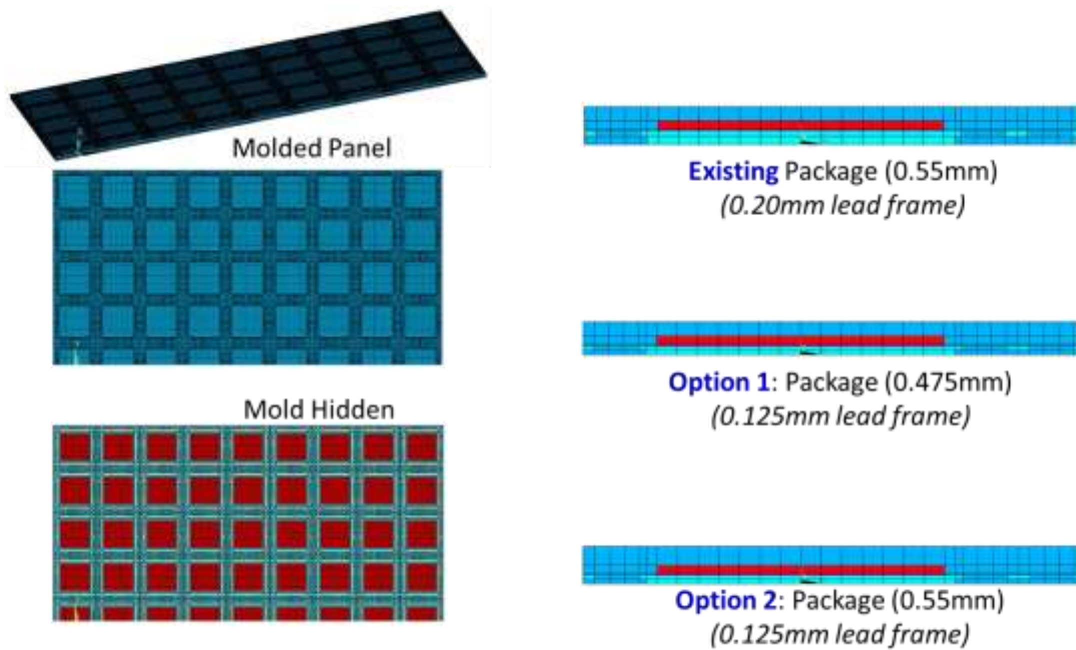

Fig. 3. Finite element model of the QFN molded leadframe strip options analyzed.

IV. Package Design Solution and Improvement

- Based on the strip warpage modeling results (Fig. 4), reducing the leadframe thickness and maintaining the overall package thickness (Option 2) is the best solution that gives the lowest strip warpage.
- Modeling results give the following important information for a "frowning" strip warpage of a QFN package:
  - Reducing the leadframe thickness results in lower warpage.
  - Considering the same leadframe thickness, reducing the overall package thickness results in higher warpage.

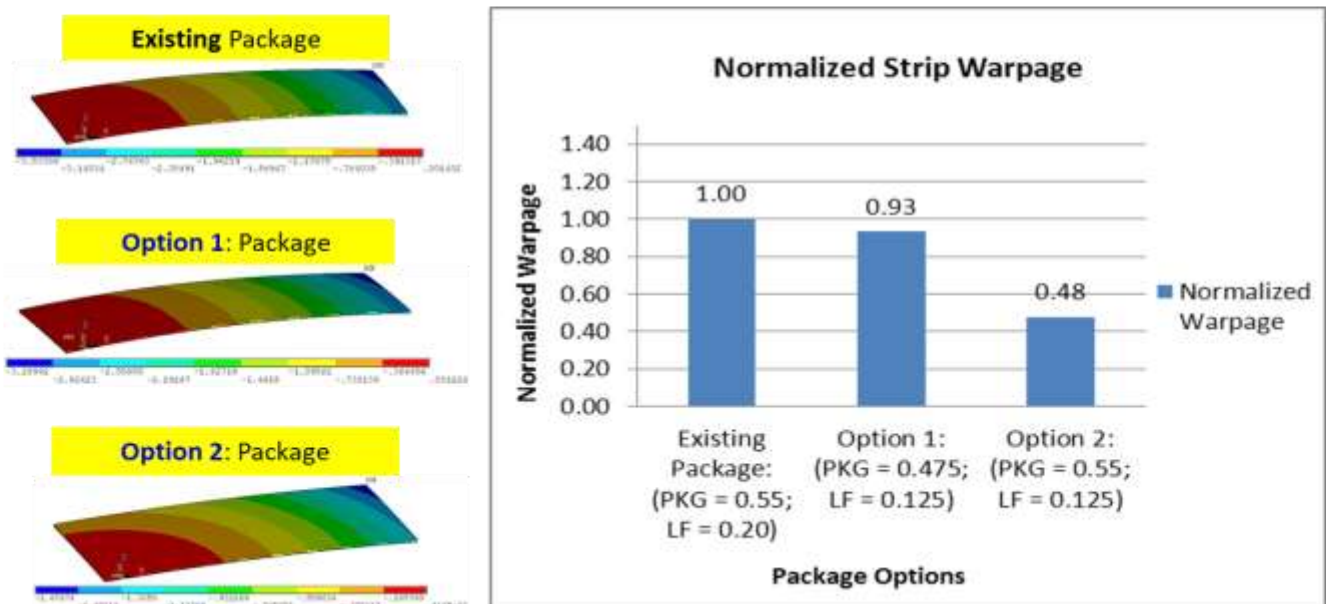

Fig. 4. Comparison of the strip warpage of the package design options considering different package and leadframe thickness.