SUCCESS STORY

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ASSIC
Austrian Smart Systems
Integration Research Center

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: K1 COMET-Centre

Type of project: CTE Compensation for MEMS Microphones, 03/2005 – 09/2017, single-firm

ASSIC

AUSTRIAN SMART SYSTEMS INTEGRATION RESEARCH CENTER

AUDIBLY BETTER WITH HETEROGENEOUS INTEGRATION

THERMAL LOADS IN MICROELECTRONIC PARTS, THUS SOUND DISTORTIONS, ARE REDUCED BY REPLACING SOLDERING WITH SUSPENSION STRUCTURES

A microelectromechanical (MEMS) microphone, as it is used in mobile phones, for example, consists of a chip in which a vibrating membrane is integrated for speech acquisition. This chip is attached to the carrier in which there is a sound aperture, see Fig. 1. Further components are attached here. For protection, the "package" is provided with a lid. When heated (or cooled), the lid and carrier deform more than the chip. This causes the chip to be pulled apart or compressed at its solder points, thus additionally tensioning or releasing the membrane. The oscillation frequency for a spoken word changes as a result and distorts the speech tone depending on the ambient temperature. The aim of the project was to replace the soldering points with a suitable fabricable structure that prevents or at least significantly reduces the distortion of the chip. The further requirements necessary from a manufacturing point of view are not dealt with here, but it had to be additionally ensured that the structure also withstands the loads caused by falling down.

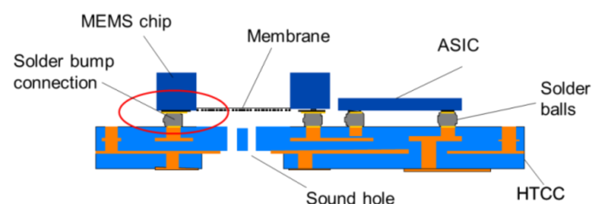

Fig. 1: Section through the original MEMS flip-chip package: the chip with the membrane is attached to the carrier with solder points. The protective cover is not shown.

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A measure of the effectiveness of temperature compensation is the elastic compliance of the membrane. The more the membrane is tensioned, the stiffer it becomes. The change in elastic compliance corresponds to the degree of speech distortion. The aim is therefore to keep the membrane's resiliency as constant as possible. The blue line in Fig. 2 shows the behaviour of the original soldered structure. When the temperature changes away from the room temperature (20°C), the membrane compliance decreases or respectively increases considerably.

The proposed solution consists of side-mounted oscillating springs arranged around the chip showing in only one direction. When heated, the chip can rotate by a small amount instead of being pulled apart. This reduces the distortion considerably and the elastic compliance of the membrane changes by only a few percent see Fig. 2, red curve. The rotation is so small (about 0.02°) that it is easily absorbed. The only remaining contribution to stiffness comes from the torsional stiffness of the springs, as they have been designed to withstand a fall from 1m without breaking.

Impact and effects

With the new suspension of the MEMS chip developed by CTR, the voice reproduction of mobile phones can be significantly improved. The solution was developed in close cooperation with the user company, so that all design manufacturing rules were met. In addition, this solution also provides a general resolution to compensate for temperature-related tensions when mounting sensitive electronic components. The solution can be implemented on conventional galvanic lines for the production of housings.

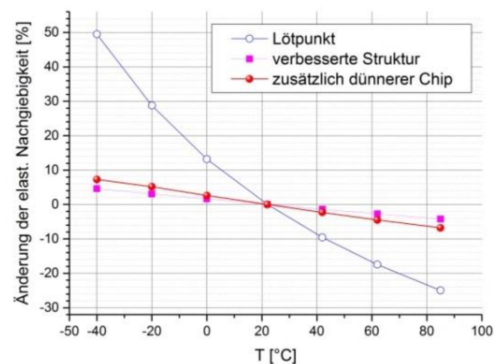

Fig. 2: Change of the elastic membrane compliance with temperature change for different chip bonding: the blue curve shows the original, the red curve the improved behaviour.

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Project partner

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This success story was provided by the consortium leader/centre management and by the mentioned project partners for the purpose of being published on the FFG website. Further information on COMET: www.ffg.at/comet