

# **Influence of assembly methods and thermal cycling on MLCC capacitors on crack appearance. Microsection study.**

*Carmen López-López<sup>(1,)</sup> Elisa Torres<sup>(2,)</sup> Sonia Reina<sup>(1)</sup>, Cristina Marcos<sup>(2)</sup>, Manuel Dominguez<sup>(1)</sup>, Jose Manuel Jimenez<sup>(2)</sup>*

*(1) ALTER TECHNOLOGY TÜV NORD S.A.U., C / Tomás A. Edison 4 - PCT Cartuja - 41092 Sevilla (Spain)*

*(2) Thales Alenia Space in Spain. C/Einstein, 7 (PTM)-28760 Tres Cantos- Madrid (Spain)*

Surface mount Multilayer Ceramic Chip (MLCC) capacitors for High-Reliability applications is a major concern for companies involved in critical and space missions, especially considering the cracks found in the ceramic in multiple configurations of ESCC (European Space Components Coordination) and MIL (Military) qualified manufacturers in the past years usually linked to mounting process.

The different mounting processes (vapor phase, hand soldering, hot air...) and the stringent requirements in terms of thermal cycles and vibrations conditions than PCBs ( Printed Circuit Board) needs to be submitted to in these hi-rel systems, have led to the need of a comparison between the different techniques used for the assembly of these MLCC capacitors subjected to different mounting techniques and multiple environmental tests.

This paper studies the susceptibility to cracking of soldered MLCC capacitors, in which a comparison is made between different assembly methods and especially the effect of different thermal cycles conditions to the soldering joints and ceramic chip capacitors. Testing is performed on size 1210 chip capacitors with different dielectrics (NPO, X7R,..), termination plating, manufacturers, and even flexible terminations.

In order to study the integrity of such assembled MLCC, a real verification assembly boards were provided by Thales Alenia Space in Spain and populated with multiple types of 1210 chip capacitors available for space customers. Since these devices are sensitive to mechanical and thermal stress, the boards were subjected to vibration and submitted to thermal cycling tests with different conditions in ALTER Technology and Thales Alenia Space in Spain. To assess the status after mechanical and thermal tests, both the capacitors and their solder connections were metallographically sectioned and examined by microscope. These tasks have been performed in ALTER Technology Material Analysis Laboratory, recently recognize by the ESA as microsectioning laboratory for PCB and assembly certification.

Finally, further discussion about different mounting, types of ceramic, termination plating and construction to detect the appropriate MLCC to be assembled at PCB level will be carried out in view of results obtained from the different microsection analysis.