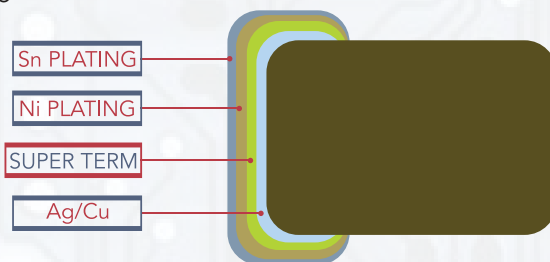


REDUCING SHORT CIRCUIT RISKS IN MLCC - SOFT TERM - - TECHNICAL NOTE -

Internal MLCC cracking can result in serious failure modes. If ceramic capacitors are subjected to severe mechanical stress, a bending crack may occur. This crack can run through two or more electrodes of opposing polarity and result in a short circuit. Typical bending cracks are shown below. In the worst case scenario, these short circuits may lead to the MLCC overheating and catastrophic failure.

SOFT TERM ADVANTAGES

- "Flexible" Termination Layer Incorporated
- Reduces Cracking due to Mechanical Stress
- Increases Thermal Shock Resistance



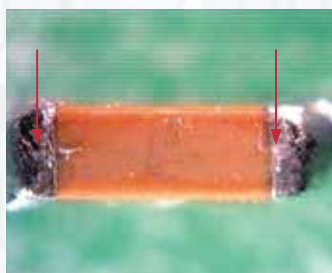
STANDARD TERMINATION



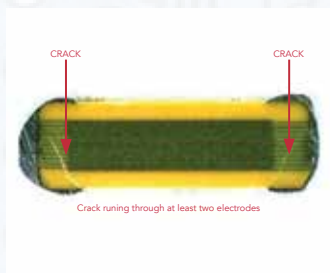
- Standard termination construction may result in ceramic cracking during PCB bending, vibration, Depanelizing, etc.

ACTUAL EXAMPLES

- Failure Mode Type 1

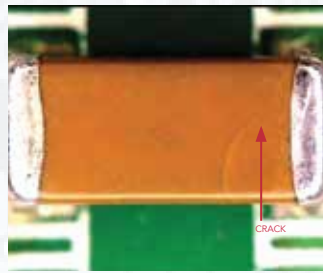


SURFACE VIEW

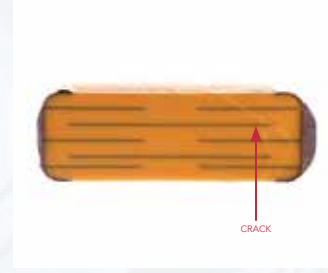


CROSS SECTION VIEW

- Failure Mode Type 2 (wetting greater than 2/3 of thickness)



TOP VIEW



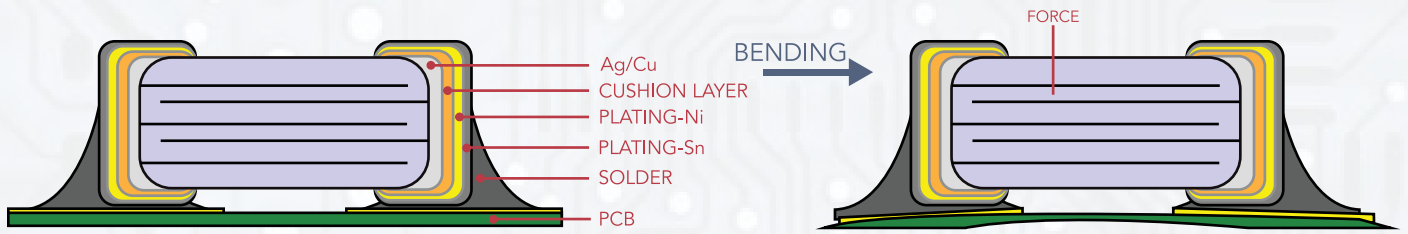
CROSS SECTION VIEW

- The failure mode results from PCB bending forces. These cracks may not be visible on the MLCC surface. Cross sectional analysis is required to identify these internal cracks.

- MLCC cracking frequently occurs during the circuit board depanelizing process. The root cause is knife (blade) vibration during the process.

GMX PRODUCT

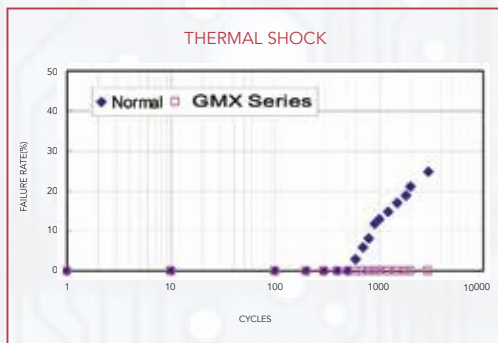
- Cal-Chip has developed the "SoftTerm" (GMXSeries), which incorporates a "cushion layer" in the termination structure. This construction effectively absorbs external forces, reduces the incidence of cracking and improves overall product reliability. SoftTerm product applications include: high temperature automotive, power circuits and other critical end products with extreme processing conditions.



- Stresses absorbed by cushion layer

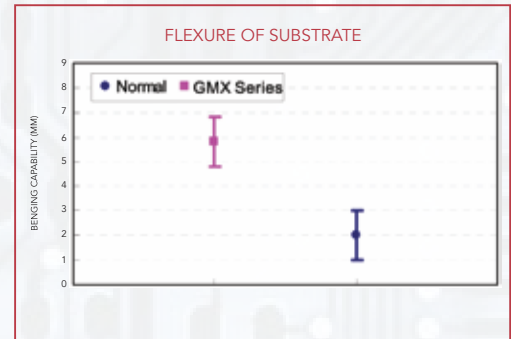
RELIABILITY/DURABILITY COMPARISON

- Thermal Shock Comparison



- Thermal shock test on standard termination results of inception of failure at 500 cycles. SoftTerm NX Series reliability improves to over 3000 cycles.

- Substrate Flexure Comparison (0805/X7R)

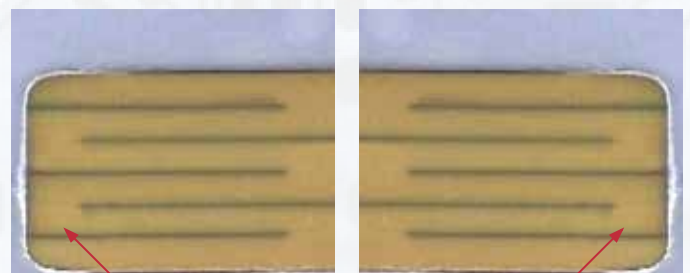


- Bending test on superterm shows an improvement of about 5.0 mm bend vs. an average of about 2.0 mm. for standard termination.

- During destructive bending test, the PCB is subjected to bending until capacitor failure. With superterm there is no cracking damage in the ceramic. SoftTerm effectively prevents ceramic body cracking during extreme mechanical stress as simulated by this test.



POLYMER Ag



NO CRACKING APPARENT IN THE CERAMIC

SoftTerm failures resulting from destructive bending test occur in the OPEN mode and not the short circuit mode typical of standard termination failures. The SoftTerm cushion layer material is a "polymer silver" material and can be seen in the above photo.

