New Stacked MLCCs to Extend Performance Capability

John Bultitude, Ph.D.
KEMET
JohnBultitude@kemet.com
Wilson Hayworth
KEMET
WilsonHayworth@kemet.com

Stacks of BX, BR, BQ, and X7R MLCCs made with precious metal inner electrodes (PME) qualified to MIL-PRF-49470 have been available from multiple suppliers for many years. These stacked capacitors with these military form factors are suitable for use in harsh environments and are available in space grade "T-level". More recently KEMET has qualified Mil-form factor 3, 4 and 5 stacks of C0G nickel base metal inner electrodes (BME) for industrial use at 200oC. These capacitors have no loss of capacitance with applied voltage and retain low ESR and so have much better ripple current performance over a broad frequency range than available X7R type stacks rated for this temperature. The increased use of Wide Band Gap (WBG) semiconductors of GaN and SiC for more efficient power conversion that operate at higher switching frequencies has led to renewed interest in these C0G type solutions particularly for resonant type topologies. The increase in frequency can reduce the size of the capacitors required but there is also a desire to reduce board-space footprint and height of the stacks. For this reason, a range of nickel BME C0G capacitors was developed using 2225 and 2220 case sizes. All of these stacks use HMP Pb-based solders to interconnect the lead to the MLCCs. However, in current surface mountable commercial and automotive grade stacks the interconnects use Pb-free solders that limit their temperature capability. By replacing solder with transient liquid phase sintering (TLPS) interconnects KEMET has successfully commercialized a range of leadless stacks that can be surface mounted using similar solder reflow processes as MLCCs. We have also demonstrated that this TLPS can bond to a variety of finishes and so tin can be eliminated. The leadless stacks can be orientated to reduce ESR and so lower power dissipation. This presentation will review these developments with respect to increasing capacitance within the available board space and realizing improved performance in power applications.