Developments for Copper-Graphite Composite Thermal Cores for PCBs for High-Reliability RF Systems

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Summary: A copper-graphite composite was selected from different candidate materials tested to determine suitability as a direct replacement of heavy copper thermal planes within high-reliability military-aerospace multilayer PCBs intended to mount and dissipate high heat loads from RF power semiconductors, with significant improvements in CTE matching for the high heat flux components. A manufacturing development process was also undertaken to develop very thin flat panels of this copper-graphite composite, required to meet IPC 6012C and other PCB industry-standard processing and manufacturing requirements. Testing with PCB manufacturing was conducted by a major mil/aero PCB manufacturer; production. Important target requirements for CTE value, thermal conductivity, thickness, panel size, minimized warpage, and processing were met.

1. Program Development Goals
(Program goals set by Naval Surface Weapons Center, US Navy; and Lockheed Martin, USA)

2. Candidate Materials Evaluated
(Materials property testing, analysis, and selection conducted by Lockheed Martin, USA)

3. Analysis of Selected Copper-Graphite Sheet within PCB
(Fabrication, testing, and finished PCB analysis for balanced and unbalanced PCBs conducted by TTM Technologies, USA)

4. Empirical Results for PCB Fabrication with Cu-Graphite Thermal Cores
(PCB fabrication, testing, and process analysis conducted by TTM Technologies, Inc., USA)

5. Results

Note: Please see manuscript for complete set of material and processing descriptions and references.