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NASA TECH BRIEF

Study Made of Anodized Aluminum Circuit Boards

The trend in electronic packaging is toward greater component density and, at the same time, increased power (watts per cubic inch). The heat generated (several hundred watts) on high power, low frequency circuits has to be dissipated quickly in order to maintain operating conditions for the mounted components.

Present circuit board materials (glass–epoxy, paper–epoxy) are poor thermal conductors. Many approaches have been attempted to obtain printed circuit board materials which exhibit good electrical properties and good thermal conductivities. The only material thus far available is beryllium oxide, a ceramic of excellent electrical and thermal properties. Brittleness, difficulty in manufacturing, toxicity, and cost are among the properties that have prevented its widespread use. Beryllium oxide is used in a limited quantity as a heat sink for transistors.

A study was initiated to find a commercially feasible material that has properties similar to existing printed circuit boards and is competitive in cost. It is believed that hard anodized aluminum can fulfill this need.

The results of this study have established the feasibility of producing hard coated aluminum core printed circuit boards. The development of a hard coating process, even without special sealing processing, produced 6061 aluminum boards with voltage breakdown strengths of 200 to 900 volts. Higher voltage strengths are obtainable by the development of special sealing and anodizing processes.

The development of techniques for the application of copper circuits to hard coated aluminum boards has demonstrated the feasibility of obtaining an electrical power circuit of high packaging density with very high thermal conductivity and mechanical strengths relative to presently used polymer materials.

While the boards produced to date have been fabricated under laboratory conditions, the techniques used to date could easily be scaled to production equipment and personnel.

The remaining problems, blistering, buildup on corners, buildup inside holes, burning, porosity, surface preparation, etc., can be solved within present technical state-of-the-art knowledge.

Notes:

1. Complete details of this study are contained in Saturn V Materials and Processes Report, SMPR 23-1, *Determine the Feasibility of Manufacturing Hard Coated Aluminum Circuit Boards,* by C. Jacobi and R. Sewell, The Boeing Company, December 16, 1965.
2. This report is available from:
   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10425

Patent status:

No patent action is contemplated by NASA.

Source: C. Jacobi and R. Sewell
of The Boeing Company
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Category 01