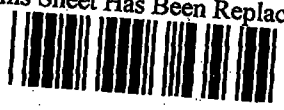
This Sheet Has Been Replaced



ABSTRACT

DIRECT ATTACHMENT OF HEAT SINK ATTACHED DIRECTLY TO FLIP CHIP USING FLEXIBLE EPOXY

An aluminum or copper heat sink is attached to a ceramic cap or exposed semiconductor chip using flexible-epoxy to provide improved thermal performance. The aluminum may be coated by anodizing or chromate conversion or the copper may be coated with nickel. Such structures are especilly useful for CQFP, CBGA, CCGA, CPGA, TBGA, PBGA, DCAM, MCM-L, single layer ceramic, and other chip carrier packages as well as for flip chip attachment to flexible or rigid organic circuit boards. These adhesive materials withstand thermal cycle tests of 0 to 100° C for 1,500 cycles, -25 to 125° C for 400 cycles, and -40 to 140° C for 300 cycles; and withstand continuous exposure at 130° C for 1000 hours without loss of strength. Flexible-epoxies have a modulus of elasticity below 100,000 psi and a glass transition temperature below 25° C, are much stronger than typical silicone adhesives, and do not contaminate the module or circuit board with silicone. The flexible epoxy may contain a material having a low coefficient of thermal expansion (CTE) in order to provide a CTE between that of the silicon die and the metal of the heat sink.