TACONIC

Finding a better way

Fusion Bonding Considerations for PTFE-based PCB Laminates

Timothy Kosto II
Director of Technology
Taconic
136 Coonbrook Road
Petersburgh, NY 12138
518.658.3202, ext. 296
timk@4taconic.com
www.taconic-add.com

Multilayer printed circuit board laminates can be manufactured using PTFE-based materials by any of several methods. These include the use of low temperature prepreg bonding materials like the Taconic TacPreg family, higher temperature PCTFE bonding films, SpeedBoard™ bonding films, FEP bonding films and fusion bonding. The objective of this paper is to provide a description of the fusion bonding process and how the lamination occurs under these conditions.

Fusion bonding PTFE requires very high temperature presses, typically employing temperatures above 362°C (685°F). The individual layers of the finished stackup are prepared by traditional methods practiced throughout the PCB industry. The layers are then placed in a press for fusion bonding. The finished stack may in some cases be constrained in the x and y directions to help minimize material movement or squeeze-out of the resin that might result from certain fusion bonding process cycles.

Once in the press, the platen temperatures are raised to 365°C at rates typically around 10°C/min. It is appropriate to reduce the rate to 3-5°C per minute near the bonding temperature to ensure that the entire stackup reaches the softening point at the same time. This will help to minimize misregistration. When the laminate temperature rises above 365°C, the resin softens. Under pressure, the softened resin from any two mating surfaces bonds together. Essentially, PTFE can be thought of like a plate of spaghetti. On a molecular level, as the temperature rises, the polymer strands move around more. The pressure forces the polymer strands into intimate contact. In this environment of moving polymer chains in close proximity, the chains near each from the two mating surfaces begin to entangle. In the culinary analogy, the spaghetti strands from one pile (laminate surface) move and entangle within the strands from the second surface (mating laminate). As this degree of entanglement increases, the two surfaces become permanently bonded, one to another by virtue of the entangled polymer chains.

In typical laminate applications, the resin must encompass traces or pads. At the high temperature employed in fusion bonding, the resin can be compression molded around the traces under sufficient pressure. However, the most robust solutions employ lower copper thickness to ensure good encapsulation of traces and pads. In certain cases, it may be appropriate to place a thin film of skived PTFE or a PTFE-based composite film between the two laminated layers to provide additional resin to

fill the spaces in the circuit. The degree of encapsulation is typically affected by temperature, pressure and the laminate composition. Generally higher temperatures and pressure result in better fill; PTFE-glass laminates will fill spaces better than a ceramic filled laminate.

Additional information about manufacturing multilayer printed circuit board laminates can be found at www.4taconic.com, including application notes with recommendations for multilayer bonding by many different techniques, including fusion bonding.