

MOISTURE AND CHEMICAL ABSORPTION IN MICROWAVE MATERIALS

Printed circuit board materials used in microwave applications come in a variety of flavors in that the Dk (or dielectric constant) can range from as low as 2.1 to over 10.2. Most microwave materials use a base resin like PTFE (polytetrafluoroethylene) in combination with fillers like glass or ceramics to modify the electrical or mechanical properties of the material. Even though PTFE alone is extremely resistant to chemical and moisture absorption, the addition of these fillers can cause remarkable changes in the moisture and chemical absorption of the laminate material.

There are various methods for reporting moisture absorption in materials. The most common method used is the IPC-TM-650 method 2.6.2.1, in which a 2 x 2 inch sample of material is etched free of copper and weighed. It is then submerged in distilled water at 23°C for 24 hours. After the 24 hour soak, the material is again weighed and the increase in weight is used to determine the % change due to moisture. This method is sometimes called D 24 23 which refers to soaking 24 hours at 23°C. Other testing that is routinely performed is the D 48 50 test which uses a similar size sample immersed for 48 hours in 50°C water. Additionally, the ASTM D 570 test subjects a similar size coupon to soaking 96 hours at 50°C. These methods, however, only test for moisture absorption.

Moisture absorption is a critical consideration as it can affect the electrical properties of the finished printed circuit board. Because of the high Dk of water, (approximately 80 Dk) any moisture penetrated in the laminate material can negatively affect the Dk as well as the impedance of the line and the attenuation.

Unfortunately moisture absorption is not the biggest problem design engineers face in terms of microwave materials. Chemical absorption is a significant factor for which there is no standardized test method. The moisture absorption numbers derived by the IPC or ASTM test methods are not indicative of the chemical absorption in a material. During the PWB manufacturing process, the material is subjected to numerous hot chemistries that can penetrate into the dielectric material. Special precautions have to be taken during manufacturing to assure that any material exposed to hot chemistries is properly rinsed and baked to assure that none remain in or on the board material and thus affect electrical performance. This type of chemical absorption is especially relevant for ceramic filled PTFE materials. The problem with absorption is that you won't see the problem until after the board is assembled and tested.

Taconic engineers understand that problems with both moisture and chemical absorption in microwave materials can negatively affect the performance of circuit boards. We have developed special proprietary treatments to ensure encapsulation of the PTFE composite around the glass weave in our products to avoid any micro-voids which could create areas of absorption. Taconic engineers have also developed proprietary final pass coats on our laminates to help prevent moisture as well as chemical absorption that can occur in microwave materials.