

TA1026 - Thermal analysis of PCB by TMA

Introduction

A printed circuit board or PCB is usually composed of epoxy resin with reinforced woven glass fibers where electrical components and conducting layers are mounted. The PCB board and the components mounted in it should have identical coefficient of thermal expansion or CTE values to prevent thermal stresses and ensures a longer lifetime. The CTE of a material can be evaluated using the thermomechanical analysis or TMA and changes in CTE values are used not only to characterize the glass transition temperature of a material, but also as a very important parameter for assessing product stability. In this application, we compare the expansion behavior and CTE values of a decade old PCB and a new PCB using TMA with differential type compression loading attachment effective for measuring samples with <2 mm in thickness.

Measurement and results

Portions cut out from a decade old PCB and a new PCB were prepared. Both samples were <2 mm in thickness. Each sample was loaded at room temperature in a differential type compression loading attachment in TMA. First and second heating TMA measurements were performed from RT up to 220°C heating at 10°C/min and applying a constant load of 100 mN.

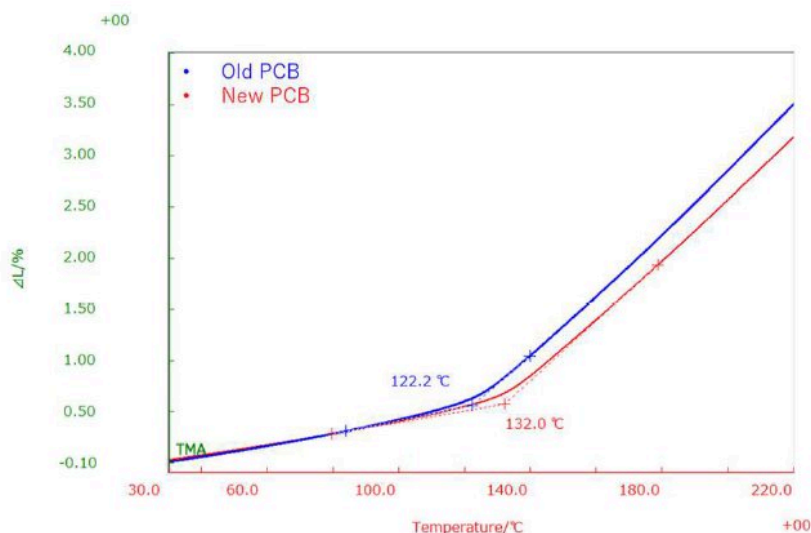


Figure 1 shows the TMA curves of old and new PCBs in which the results reveal expansion as indicated by the increase in length on both samples immediately even at the start of the measurement. Then, we can observe a sudden increase in expansion at more than 120°C due to glass transition phenomena. The inflection point indicating glass transition temperature is 10°C higher in new PCB compared to the old PCB which is a good indication of dimensional stability, better

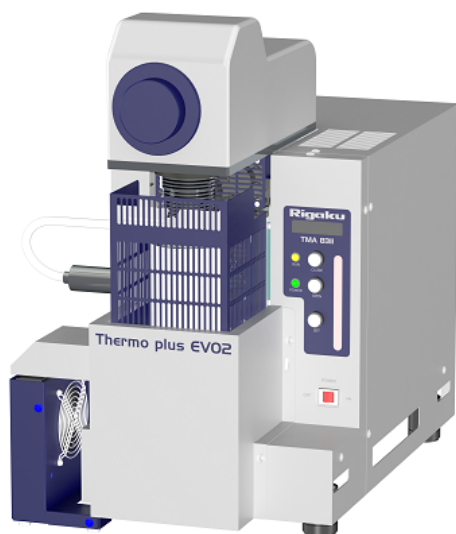
resistance to thermal stress, moisture. However, continuous usage for 10 years has caused a degradation on the thermal property as revealed in the decrease in glass transition temperature. Table 1 shows the CTE values at a base temperature of 30°C and %expansion of old and new PCBs. Here, we can observe that the CTE and the expansion percentage is nearly the same at 40°C and that as the temperature increases. The difference in CTE values has drastically increased in the old PCB than in the new PCB especially after glass transition temperature.

Table 1: CTE and % expansion in PCBs at a base

Temp °C	Old PCB		New PCB	
	% Expansion	CTE*	% Expansion	CTE*
40	0.048	4.83	0.046	4.58
60	0.155	5.17	0.146	4.87
80	0.275	5.50	0.257	5.15
100	0.412	5.89	0.377	5.39
120	0.590	6.56	0.522	5.80
140	1.039	9.45	0.826	7.51
160	1.613	12.41	1.370	10.54
180	2.212	14.75	1.944	12.96
200	2.844	16.73	2.541	14.95
220	3.490	18.37	3.151	16.59

*CTE values: __*10⁻⁵ (1/K)

Related products



TMA8311

TMA is the measurement of a change in dimension or mechanical property of the sample while it is subjected to a controlled temperature program.