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Environmental and mechanics influence on functional behavior of electronics products with flexible printed circuit boards with embedded passive component

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Abstract – The combination of different conductor and non-conductor materials both presenting flexible characteristics has leaded to the development of technical procedures to miniaturize electronic circuits. This work evaluates the impact caused by the environmental and mechanical stress on the functional behavior of flexible printed circuit boards (FPCB). FPCB samples with embedded passive components were submitted to different humidity and temperature conditions. Weibull curves were used to determine the life cycle of the analyzed materials. According to the results, the FPCB electrical resistance is strongly affected by humidity. FPCB with embedded component presented high mechanical reliability and potential opportunities in electronics miniaturization.

There is no a complete flexible product available on the market and during many times the researchers are looking for looking for non complex techniques and low cost possibilities to integrate polymeric materials and conductor or semiconductor materials with mechanic flexibility to be used on process to manufacture miniaturized flexible printed circuit board with free conformable mechanic design [1]. The big challenge, however, it is to create a process with reliable and similar results or greater than traditional rigid PCB assembled with surface mount devices. The study shows the evaluation of two different samples of flexible circuits with embedded component under different mechanic and environmental stress condition [2, 3].

The materials used on flexible electronic circuits were the polyimide, NiCr paste, copper and carbon paste. The apparatus of that experiment was based on international procedures [4] and used thermal chamber to simulate environmental conditions and mechanic equipment with sensible and precision for mechanical stress [5]. Statistic Weibull Software was used to generate the life curves, based on data results of tests, as showed in figure 1. Today, is very common use of surface mount components assembled on PCB, yet. The challenge of tests was to compare and evaluate the limits of bending curvature of flexible circuits, figure 2, without to affect the good functional response of electronic circuit. The results show that some electrical characteristics like tolerance of resistance value were strongly affected by humidity environment. In other hand, the resistance value not changed during mechanic tests and the failures were detected only in copper trace, figure 3. The results shows the sensible areas that must be carefully observed and the real possibility of mechanic free design of FPCB when applied to electronic passive components.

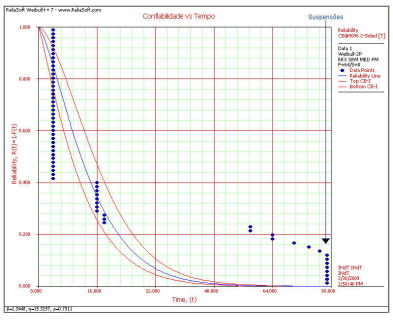

Figure 1: Life curve for Humidity Test

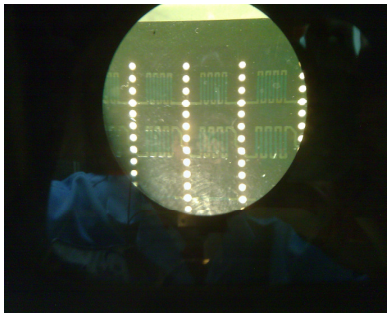

Figure 2: Embedded resistor layout

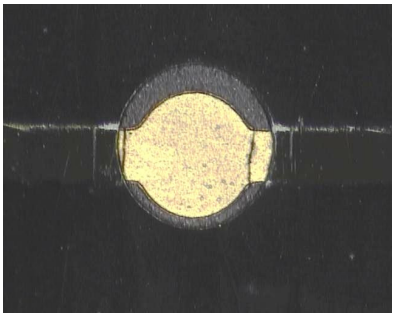

Figure 3: Mechanic failure on copper trace

References

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[5] IEC 60068-2-30H International Humidity Test procedure.