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Capacitive touch isn't the only game in town

IN THIS ISSUE

Selecting PCBs for Mobile Infrastructures

By Art Aguayo, Sr. Market Development Manager, Rogers Corporation

Base station designers for mobile infrastructure networks today have a large selection of high frequency printed circuit board materials and suppliers to choose from at the initial stage of their projects. The material is a critical component of the system and proper care must be taken when making this choice, since the success of the project could be greatly influenced by the printed circuit board (pcb) material. The old, basic method is greatly flawed, as it does not take into account the variation in electrical performance outside of the lab where data sheet values were obtained nor does it consider the true cost of a pcb, meaning it does not consider the price of the finished circuit. When selecting the material, Performance, Reliability and Cost should be considered.

Performance

Commercial high frequency PCB materials today are grouped into two categories based on the resin system. One grouping uses thermoplastic resins such as PTFE while the second group uses a variety of thermoset resins. Both of these families of products combine the resin system with some type of reinforcement. Woven glass and or ceramic fillers are the most common choices. These composite laminates also come clad with surface metallization, copper foil being quite standard. Some materials have the option of being available with thick metal cladding.

When designing high power components, thermal management is an important factor. Two ways in which this can be done is one, keeping losses low and two, selecting materials with higher thermal conductivity. Insertion loss is made up of both dielectric losses and conductor losses. Dielectric losses are lower when working with materials with low dissipation factor (loss tangent) while working with copper with lower surface roughness assists in keeping conductor losses down. The impact of these parameters is also affected by the frequency of operation and the thickness of the substrate used.

One material property not often considered by electrical engineers, is thermal conductivity (Tc). Depending on the value of this property, sometimes a lower operating temperature can be achieved when selecting a material with higher Tc even if the dissipation factor or conductor roughness are higher.

Reliability

One factor that needs to be considered, is plated through hole (PTH) reliability. Newer designs require circuit technology that uses a multilayer approach to either reduce the overall circuit size or to integrate more functions into a single circuit board construction. Two factors to consider when performing PTH reliability analysis. are: short term reliability, this has to do with the behavior of the laminate's coefficient of thermal expansion and its effect on the PTH's as it goes through high temperatures, and the second is long term reliability, which has to do with the circuit function once it is in the field. Newer base stations are designed to be mounted outside of buildings. They must be able to survive extreme environmental temperatures.

PTFE goes through a significant increase in CTE between 17°C to 24°C and outside of those temperatures it levels off somewhat. Since a circuit board can see temperatures below 17°C in the field, one should be concerned about the CTE at low temperatures too.

When testing PTH reliability, consider high temperature exposures during the PCB fabrication process. PCB's may undergo multiple solder reflow operations. which can cause stresses on the via's not evident at this stage, but could create a problem later in the field. The material selected should be one that can pass short term and long term PTH reliability tests. Detailed evaluations for PTH reliability were conducted on Rogers RO4350B high frequency laminate and RO4450B bonding prepreg, using a daisy chained PTH test coupon. The via hole diameter ranged in aspect ratios from 3:1 to 18:1 and the total thickness of the PCB's ranged from 0.060" to 0.175".

There were two components of the pass/fail criteria, electrical and mechanical. If the value of the resistance of the daisy chained vias increased by more than 10% during the heating cycle in the environmental chambers, it was considered a failure. For the mechanical criteria, this was based on visual inspection of the cross sectioned vias. Evidence of cracked plating in the hole wall was considered a failure.

PTH reliability for this material set is quite high. Although there are several options when working with PTFE based materials, their different CTE properties mean they behave in a different manner from each other when performing PTH reliability testing. Some PTFE based laminates have also proven to be as reliable as RO4000 materials. Designers should conduct careful electrical and mechanical evaluations to determine the combination fitness for use over the entire life of the end product.

There is no high frequency material that is considered the best option in all three areas of performance, reliability and cost. This work needs to be done by the designer. A solution that best fits one project may not necessarily be the right option for another. Just as there are three areas to consider when selecting the material, work with the PCB facility and laminate supplier to keep in mind best in class practices in DFM. Maximizing the benefit/value proposition of today's systems starts with a good foundation, and this foundation can many times be the high frequency material which carries the load from the lab to the field. ■

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Distracted Driving Solutions

By Daniel Ross, Chief Executive Officer, Illume Software

Distracted driving: it's an issue that's not going away anytime soon. With more than 2.5 billion text messages sent daily in the US—a 100 percent increase from a year ago—and the corresponding growth in distracted driving incidents that killed more than 5,400 people and injured nearly 500,000 in 2009, distracted driving is a growing problem in search of a solution. Over 70 million Americans now own smartphones that contain a myriad of features beyond text and voice that further add to driver distraction.

Distracted driving technically encompasses multiple driver behaviors; eating or drinking, reading, grooming or even changing the radio station. But none has generated so many statistics and found its way into the headlines like cellphone use, particularly texting.

Distracted driving diverts the attention of the driv-