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NO SPEED LIMIT FOR AUTOMOTIVE ELECTRONICS

LIGHTNING SPEED LAMINATES

High-Frequency Laminates Help Avoid Car Accidents

SUMMARY

Advanced PCB technology enables much of the automotive-based sensing systems that facilitate adaptive cruise control, active brake assist and blind spot detection. The proper choice of the high-frequency laminate to be used in these PCBs can be critical.

by John Coonrod
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The automotive industry continues to make many advances each year and some of these require advanced PCB technology, which enable much of the sensing systems that facilitate adaptive cruise control, active brake assist and blind-spot detection. The technology is based on radar theory and has been well known for many decades.

Some of the advances in PCB technology enabling the automotive radar applications are due to attributes of high-frequency circuit materials. These PCB materials are specialized and have unique properties allowing them to perform at the high frequencies required by these applications. The blind spot and other near-car detection systems operate around 24 GHz. Most standard PCB materials are unstable at these frequencies; however, there are several high-frequency circuit materials being used at these frequencies without issue. Rogers Corporation supplies their RO4350B™ high-frequency laminate in many of the automotive near-car detection systems. The material has proven its high-frequency capabilities and it offers the circuit fabricator a process that is more aligned to standard PCB materials. Many of these PCBs are cost sensitive and often the RO4350B material will be used in conjunction with standard PCB circuit materials in order to have a "hybrid PCB" that is more cost effective, yet still meets the demanding electrical requirements. The RO4350B laminate is compatible with standard PCB circuit materials and, in most cases, even non-standard materials.

Multiple issues can be critical for an automotive sensor application as it relates to the PCB and, more specifically, to the high-frequency material that is used. One issue is the ability for multiple circuits to be manufactured with the same controlled impedance; having a laminate with a tight control of the dielectric constant (Dk) is important. The RO4350B laminate is specified to have the Dk value controlled to a tolerance ± 0.05, which is better than ± 1.5%.

The adaptive cruise control (ACC) applications are typically more demanding. The operating frequency is usually about 77 GHz and this frequency is even outside of the range of many high-frequency circuit materials' capabilities. The RO3003™ high-frequency laminate is being used in many of these applications with great success. There are several reasons and, obviously, Dk tolerance would be one of them. The RO3003 laminate has an excellent Dk tolerance of ± 0.04 and at this high frequency, concerns with insertion loss are paramount. The RO3003 laminate offers an extremely low dissipation factor of 0.0011, which ensures the dielectric loss component of insertion loss will be very low.

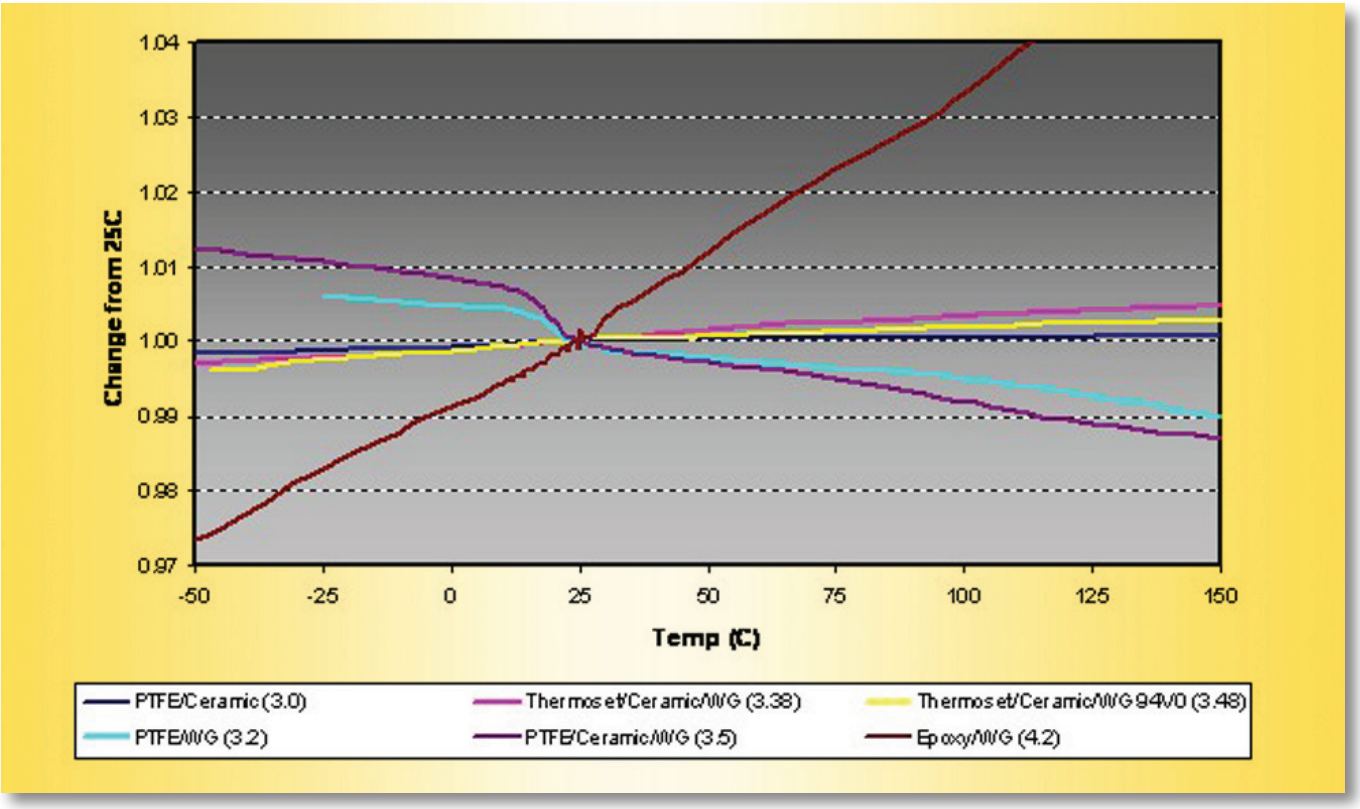

Figure 1: TCDk chart showing the results of several PCB circuit materials.

Another topic of interest would be the effects of temperature on the performance of automotive sensing circuits. The circuits are not generally exposed to very high temperatures, although there is an attribute of PCB laminates which can be concerning with moderate temperature changes. The temperature coefficient of Dk (TCDk) is the property where the laminate will change Dk value with a change in temperature. It is common for some laminates to have a TCDk of +200 ppm/°C or more. With an application that is very sensitive to a change in impedance, which can be directly related to a change in Dk, the TCDk property can be a concern.

In Figure 1, a graph of the TCDk property is shown for several common laminates used in the PCB industry. The curve which is labeled PTFE Ceramic (3.0) is the most linear on the chart, representing the least change in TCDk across the temperature range. This material is Rogers RO3003 circuit material.

The previously mentioned concerns with Dk tolerance and losses are typically well considered, however, sometimes designers may overlook the TCDk value and that potential effect will not be obvious in laboratory environment testing.

Many things should be considered for the concerns of automotive sensing applications, and the proper choice of the high-frequency laminate to be used in the PCB can be critical. **PCB**

John Coonrod is a Market Development Engineer for Rogers Corporation, Advanced Circuit Materials Division. He has more than 24 years experience in the PCB industry, about half of which in the flexible PCB industry doing circuit design, applications, processing and materials engineering. Coonrod has also supported the high frequency rigid PCB materials made by Rogers for the past 10 years. Reach Coonrod at john.coonrod@rogerscorporation.com.