

# Center for Dielectric Studies (CDS)

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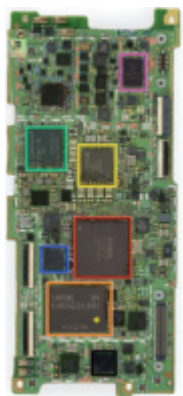
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## Understanding Dielectric Materials

*Motherboard of a smart phone, having many capacitors supporting the CPUs.*



Research at the Center for Dielectric Studies (CDS) has furthered understanding of dielectric materials, including the requirements for raw materials and the properties that result from various compounds and processing approaches. The Center's research has shed new light on understanding the defect chemistry of barium titanate, a key ingredient of many of the dielectric powders. Fast firing has enabled devices to be produced with less porosity in the electrodes and smooth electrodes.

In this work, CDS researchers have highlighted a new theory and equation that provides for more accurate prediction of the lifetime of devices. This, in turn, provides much better estimates of the reliability of electric systems and subsystems. Electrical devices across consumer electronics, automobile, telecommunications, computer, aerospace, military, and medical fields, all require the use of multilayer capacitors. Their reliability is critical and is often the initial weakness in failed electronic systems.

Multilayer capacitors on average have a 40:1 ratio over integrated circuits in terms of circuit components. It is an industry that impacts all aspects of electrical systems. There are 3 x 10<sup>12</sup> multilayer capacitors manufactured and sold every year. The image shows many surface mounted capacitors on the motherboard of a smart phone.

This work is aimed to replace a 50-year-old empirical equation that no longer holds and requires extensive testing that is costly to estimate long-term reliability. The new CDS theory and equation only requires three independent measurements, a major cost savings, and also is a much more accurate lifetime performance predictor.

**Economic Impact:** The world market for capacitor components is estimated to be \$16 billion annually. Passive electronic components in handheld electronics are constantly evolving to support system trends in functionality and miniaturization. Reliability is essential to their value. However, indirectly we are considering the impact of all electronic systems that rely on using capacitors, and this then impacts all aspects of the high-tech economy.

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