PRESIDIO COMPONENTS, INC.

What exactly causes BME failures?

We are frequently asked this question.

The short answer is "oxygen vacancy." The long answer is…

The thermal processing of the ceramic part of the capacitors (called sintering) occurs at very high temperatures, usually above 1000° C. Typically, a precious metal (palladium silver alloy for example) which does not oxidize during sintering is selected to form the electrodes or plates of the capacitor (PME – "Precious Metal Electrodes").

As the name implies, BME caps use "Base Metal Electrodes" such as nickel, which would normally oxidize at high temperatures. BME caps are sintered in a non-oxygen or reducing atmosphere so that the nickel stays in a metallic or non-oxidized state.

The down side is that the reducing atmosphere takes away oxygen from the ceramic dielectric. The ceramic then acts more like a semiconductor and less like an insulator.

If a metal is exposed to high temperatures in an oxygen atmosphere, the metal turns into an oxide also known as "ceramic." Conversely, if a ceramic is exposed to high temperatures in a non-oxygen (reducing) atmosphere the ceramic wants to become a metal again.

It also needs to be said that a capacitor ideally needs to have very conductive metal plates and a non-conducting, and very insulated, ceramic dielectric.

BME caps are thermally processed in a mixed gas (reducing) atmosphere which prevents the nickel plates from oxidizing, but yields ceramic dielectric layers with oxygen missing (vacant) from their crystal lattice structure. The missing oxygen acts as a conductive path. This makes BME caps poor insulators compared to PME caps.

A second thermal process, in a slightly oxygen rich atmosphere, is used to "drive" oxygen back into the ceramic in order to make the ceramic less conductive. However, this is a compromise, as the process does not remove all the oxygen vacancies.

In order to mitigate the problem, oxygen-rich dopants, or additives, are added to the ceramic formulation. However, the dopants typically contain loosely bonded oxygen and the added oxygen can be lost over time. The loss of oxygen is accelerated with temperature and applied electric fields.

BME capacitors have reasonable electrical properties, a reasonable life expectancy, and very low costs. Exactly what cell phones and other similar products need. However, in terms of electrical properties, the insulation resistance is typically one or more orders of magnitude lower than PME. As a result, in terms of life expectancy, the time to "wear out" is typically an order of magnitude shorter. This is not an ideal component for applications where reliability is important.

Call Presidio Components for high reliability ceramic capacitors!

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