Constant Acceleration Screening of Hybrid DC-DC Converters

Constant Acceleration (centrifuge) testing is a screen used to verify the robustness of a hybrid microcircuit. It is performed only in one axis, the Y1 axis.

This test originated in the testing of discrete transistors, where it confirmed the die attachment of the transistor to the case. Because the mass of the die is so low, very high accelerations are used to achieve a force high enough for screening.

In hybrid microcircuits, constant acceleration testing confirms the attachment of substrates and other components. The acceleration levels are adjusted according to the mass of the unit. However, 3000 G's is the lowest screening acceleration listed in MIL-PRF-38534.

Hybrid DC-DC converters have relatively heavy magnetic components which are attached to the substrate with various methods, including epoxies and other adhesives. When these heavy components are subjected to 3000 G's acceleration, very large forces result.

It is an unintended consequence of the screening requirement, when applied to the mounting of heavy magnetic components, that the screening requirement dictates the construction method, rather than the actual application requirements.

To withstand the forces generated by the 3000 G constant acceleration, it is generally necessary to use a relatively rigid adhesive or epoxy to secure the magnetic components.

The magnetic components either have ferrite cores or powdered metal cores. However, in both cases, the magnetic core material is within a ceramic matrix which is very brittle and susceptible to mechanical cracking if damaged.

Many long duration spacecraft applications for hybrid DC-DC converters result in environments where the hybrid DC-DC converters are subjected to large numbers of temperature cycles.

The use of a hard epoxy for magnetic component attach in order to meet a 3000 G constant acceleration screen increases the likelihood that the brittle magnetic core material may crack and ruin the magnetic core properties. This results in magnetic component failure.

Therefore, it may be qualitatively concluded that demanding a 3000 G constant acceleration screen may inadvertently result in a design that is less robust for actual long term space applications.