

## **Deep Charging Evaluation of Satellite Power and Communication System Components**

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Deep charging, in contrast to surface charging, focuses on electron penetration deep into insulating materials applied over conductors. A classic example of this scenario is an insulated wire. Deep charging can pose a threat to material integrity, and to sensitive electronics, when it gives rise to an electrostatic discharge or arc. With the advent of Electric Orbit Raising, which requires spiraling through Earth's radiation belts, satellites are subjected to high energy electron environments which they normally would not encounter. Beyond Earth orbit, missions to Jupiter and Saturn face deep charging concerns due to the high energy radiation environments. While predictions can be made about charging in insulating materials, it is difficult to extend those predictions to complicated geometries, such as the case of an insulating coating around a small wire, or a non-uniform silicone grouting on a bus bar. Therefore, to conclusively determine the susceptibility of a system to arcs from deep charging, experimental investigations must be carried out. This paper will describe the evaluation carried out by NASA's Marshall Space Flight Center on subscale flight-like samples developed by Space Systems/Loral, LLC. Specifically, deep charging evaluations of solar array wire coupons, a photovoltaic cell coupon, and a coaxial microwave transmission cable, will be discussed. The results of each evaluation will be benchmarked against control sample tests, as well as typical power system levels, to show no significant deep charging threat existed for this set of samples under the conditions tested.

Key words: deep charging, electrostatic discharge, electron radiation, satellite power systems