IMPORTANCE OF DIFFERENTIAL CHARGING FOR CONTROLLING BOTH NATURAL AND INDUCED VEHICLE POTENTIALS ON ATS-5 AND ATS-6

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ABSTRACT

A review is given of what has been learned about spacecraft charging from the ATS-5 and ATS-6 satellites. The first observation of large (i.e., kilovolt) spacecraft potentials was made on ATS-5. The record potential to date of -19 kV was observed on ATS-6. The connection between spacecraft anomalies and spacecraft charging was inferred from a study of the local time dependence of ATS-6 charging events. The importance of differential potentials in affecting the current balance to a spacecraft was realized through the observations of potential barriers about ATS-6. A large number of active charging experiments have been carried out with the ion thrusters and neutralizers on both ATS-5 and ATS-6. Electron emission alone can only partially discharge a negatively charged spacecraft because of the fact that negatively charged surface dielectrics retain their negative charge. Differential charging can limit the currents from particle emitters, and consequently the time constants involved in charging and discharging a spacecraft can be controlled to a large extent by differential charging. Simultaneous emission of both positive ions and electrons can completely discharge both the spacecraft mainframe and the dielectric surfaces.