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DEVELOPMENT OF NEXT GENERATION ACTIVE SPACECRAFT POTENTIAL CONTROL (ASPOC-NG) INSTRUMENT FOR SCIENCE MISSIONS

Abstract

Fundamental plasma processes in space are studied in the Earth's magnetosphere, interplanetary space or other planetary environments. Interactions between spacecraft, space plasmas and solar UV photons generally result in electrostatic surface charging of spacecraft external surfaces. For instance, a satellite can be charged negatively when located in the Earth's shadow due to its interaction with suprathermal electrons in the Earth's magnetosphere, whereas surface materials exposed to the sun might develop a positive potential due to the emission of photo-electrons. These effects can compromise the accuracy of plasma measurements acquired by scientific instruments and pose a risk to onboard electronics. The active spacecraft potential control (ASPOC) system developed in the 1990s emits positive ions to neutralise the satellite potential, such as used in several missions like Geotail, Equator-S, Cluster, Double Star and MMS. With the experience gained, the next generation of the active spacecraft potential control (ASPOC-NG) instrument has been developed over the last three years. This includes two emitter modules, one for ion and one for electron emission. The modules were developed by FOTEC and the electronics control unit by IWF. The main objective was the reduction of mass and power consumption to comply with the requirements of future scientific missions. The previously used capillary-based emitter was replaced by porous tungsten needle multi-emitter. This allows a higher mass efficiency, while the liquid metal propellant feeding is still protected from surface contamination. The main power consumption of the test module was caused by the heater for liquefying the propellant. Therefore, the propellant was switched from

pure indium to an indium-gallium alloy, which reduces the heater power consumption by 68 Component tests of both emitter modules and the electronics were carried out separately. Afterwards, they were characterised in combination during a coupling test on system level. Both ASPOC-NG instruments for positive and negative charge compensation and their performance values will be presented. These values qualify ASPOC-NG as a low resource spacecraft potential control device candidate for future magnetospheric missions to study electron heating in space and astrophysical plasmas.