SPACE POWER SYMPOSIUM (C3)
Space Power Technologies and Techniques (2)

Author: Mr. SUNGSOO JANG
Korea Aerospace Research Institute (KARI), Korea, Republic of, ssjang@kari.re.kr

AN ANALYSIS OF POWER PERFORMANCE FOR KOREAN LEO SATELLITE

Abstract

In general, satellite electrical power system (EPS) plays an important role in its mission performance. EPS shall provide power generation, energy storage, and power control and distribution to support satellite mission during lifetime. To perform the mission successfully, the satellite should be provided with the sufficient power until end of life (EOL). To achieve energy balance per One-Day mission scenario, the battery shall be charged fully at the end of One-Day mission. To provide maximum solar array power generation, maximum peak power tracking (MPPT) method has been developed for spacecraft power system. Solar array generates primary power with high efficiency solar cell. To compensate for the solar cell's degradation at EOL in satellite, the solar array shall be designed to generate power with margin. When the spacecraft exits eclipses, the peak output power of a solar array becomes very higher than its peak output power in the normal sunlight operation power due to lower temperature. To avoid stress of electronics to handle main bus power from solar array power, the spacecraft power system should dissipate high excess power at the beginning of mission and sun entrance after eclipse. Battery is used for secondary energy source in space program. It shall be designed to provide energy to satellite loads in eclipse and maximum power demand for payload operation in sunlight. To get the high quality images and to perform the multi mission of satellite, the battery shall be required to provide higher energy with smaller sizing and lighter weight. For battery design in Korean LEO space programs, the trade-off studies for several types of battery proven in space have been investigated. This paper summarizes the benefits and/or drawbacks of solar array and battery candidates, the design impacts of electrical power system, the results of electrical and thermal performance analysis with respect to satellite mission scenario, fading characteristic of solar array and battery during life time, and mechanical configuration to mount on satellite. And the paper describes the results, methods and input data used in the energy balance at End-of-Life, worst case, Energy Balance analyses for Science Mode operations in Korean LEO Space Program. Both 10:35 AM and 10:50 AM crossing time are considered, so the power performance in each case is analyzed with satellite roll maneuver according to payload operation concept. Cases considered during the analysis effort were each payload roll maneuvers degrees for LTAN (Local Time Ascending Node) of 10:35 AM and 10:50 AM. In addition, data transmission to the KGS (Korea Ground Station) during eclipse is investigated at LTAN of 11:00 AM, to assess the greatest science mode battery DOD (Depth of Discharge).