

SPACE POWER SYMPOSIUM (C3)  
Interactive Presentations (IP)

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A GENERIC FINE-GRAINED ENERGY BUDGET FOR SATELLITE APPLICATIONS

**Abstract**

This paper describes the formulation of the electrical energy budget of the communication satellite “Swayam” made by students of College of engineering Pune. Swayam hosts a passive magnetic attitude control system, achieving two axis stabilization, allowing the satellite to rotate about the antenna axis. As a result, power generated by the body mounted solar panels is variable and unregulated which lead to the design of comprehensive and precise energy budget. The satellite motion in the sun synchronous orbit has been modeled using the two line elements and SGP4 model, which were used to calculate satellite to sun vector and consequently the angles made by every face with this vector every 8 times in a seconds. Using these instantaneous cosine values, solar constant and physical and electrical parameters of solar cell, average energy generation over 14 orbits (24 hours) has been calculated. The discrete values of generated power are analysed for their occurrence over a period of time and its probability curve is used to calculate the battery charging current so as to maximise the power on generation side. Worst case consumption of all loads of Swayam satellite have been characterised considering various factors like variation over a temperature range. Average consumption for a day has been calculated for periodic and aperiodic loads. Using generation and consumption profile with time, battery capacity has been determined with sufficient margin on depth of discharge. Power modes for the satellite are predefined based on the battery charge. The recovery of system from low power mode is ensured by controlling shut down operation of load modules with the help of energy budget. These calculations have been practically validated on the satellite during long run test (160 hour). Power generation was emulated using solar panel simulator which takes given orbit’s irradiance profile into consideration. This comprehensive energy budget of Swayam satellite can be used for various sun synchronous orbits.