43rd STUDENT CONFERENCE (E2)
Educational Pico and Nano Satellites (4)

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SWAYAM - PASSIVELY STABILIZED COMMUNICATION SATELLITE

Abstract

Swayam is a pico-satellite being developed by students of College of Engineering, Pune. Project Swayam aims at building a passively stabilized communication satellite of dimensions 10 X 10 X 11.3 cm in low earth orbit. Student satellites offer a distinct challenge in terms of reliability and interdisciplinary nature of design. To achieve the highest standards of design and fabrication, the project is organized into five constituent subsystems. Attitude control is achieved by a passive magnetic attitude control system to satisfy the space and energy constraints. This system consists of an orthogonal arrangement of magnet and hysteresis rods. Volume, strength and placement of magnetic materials are the major design considerations. A numerical simulation has been developed to conclude the effect of various design parameters on stabilization time and its feasibility for the communication payload. Swayam has a half-duplex communication subsystem. Beam of the antenna is optimized to offer maximum pass time in conjunction with the available pointing accuracy. The beacon, which should be audible, is transmitted at low power using N-FSK scheme. To satisfy the power budget of the satellite, the autonomously sent beacon is sent at lesser power than the digital payload data. The power subsystem of the satellite is fully analog capable of functioning independently. Maximum regulation is achieved by using highly efficient power conditioners. The power budget is reverse calculated, accounting for most of the critical component consumption and losses. Load protection system is indigenously designed with triple redundancy for hierarchical control exercised by the on board computer. On board Computer system is control system for the satellite. It is a microcontroller based, fault tolerant, interrupt driven system. Real time control, low power consumption and continuous autonomous operation and situation handling are the salient features of OC. Software level tri modular redundancy with error correction code makes OC radiation tolerant by correcting single bit flip errors" decking of PCB's is implemented to give structure more rigidity and less hotspots due to internal heat generation. Staircase configuration of 4 batteries ensures that the first mode of vibration is well above the experienced frequency during launch. And the mass of this entire assembly is restricted within 1000g. Swayam as a template is ideal for carrying low profile payloads which

do not require magnetically clean environment. Swayam is also an experiment which shows the cohesive application of passive stabilization for a communication satellite in low power environment.