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DESIGN OF ONBOARD COMMUNICATION SYSTEM FOR THE NANO-SATELLITE STUDSAT-2A/2B

Abstract

STUDSAT-2 is a STUDent SATellite program which aims to build twin Nano-Satellites each weighing approx. 10 kg with the dimensions of 30 x 30 x 20 cm cube with an objective of demonstrating Inter-Satellite Communication for the purpose of improving temporal resolution for remote sensing applications. Communication system forms the critical subsystem of a satellite. STUDSAT-2 has 3 communication links: Ground to Satellite (Uplink),Satellite to Satellite (ISL) and from Satellite to Ground (Downlink).This paper presents the overall design architecture of the communication system of STUDSAT 2A/2B to provide a link between the Satellite and the Ground Station.

The various design approaches considered during the development of communication module is presented. The communication system is divided in to three sub-modules: Uplink, Downlink and Beacon Module operating in amateur frequency bands. The link analysis for communication channel between Ground Station and the Satellite at the low elevation of 10degree for an orbit altitude of 600 to 900 Km range is described. The overall system design explains the integration of the communication module with Onboard Computer (OBC) for Uplink, Downlink and Beacon. Testing of each sub-module and the integrated modules with the OBC for STUDSAT-2A/2B is elaborated. The communication system sends the telemetry data, the captured image data and the data obtained by ISL of STUDSAT-2A/2B. The image data of 1.3MB will be compressed to 600KB onboard. Data Downlink is chosen to be in UHF Band (435 to 437MHz) with the data rate of 9.6kbps in FSK modulation to download the complete image in a single pass of average 8mins over the ground station with the ground station. 20bps is chosen for Beacon in CW mode. Implementation of AX.25 protocol for Downlink the Satellite health parameters and the Beacon are described. Uplink is chosen to be in VHF Band (144 to 147MHz) with the data rate of 1.2Kbps in FSK. The tele-commanding involves commanding in FSK for particular operation on the satellite from the ground station. The DTMF signals are up commanded to reset incase the Satellite becomes non-responsive.

The design process also involves the fabrication and testing of Monopole Antennas. As the radio system must be able to communicate with the ground regardless of the orientation of the Satellite in the orbit, the Omni-directional patterns are chosen. The Uplink, Downlink, Beacon Antenna are designed

and simulated in HFSS for the gain, placements, radiation patterns and the other parameters for various conditions.