Paper ID: 30741
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SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Near-Earth and Interplanetary Communications (4)

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S- AND X-BAND ANTENNA DESIGN FOR ESA'S UPCOMING OPS-SAT NANOSATELLITE

Abstract

OPS-SAT is devoted to testing, demonstrating and validating novel mission control- and operational concepts in flight that will become possible once satellites will fly more powerful on-board computers. Due for launch in 2017, for the present OPS-SAT will fly at a maximal altitude of 620 km in a Sun-synchronous orbit. Experimenters will have the opportunity to upload and test new control software as well as reconfigure hardware during the mission. As a platform OPS-SAT uses a triple unit CubeSat (30 cm x 10 cm x 10 cm) with deployable solar panels on each side. For communication, an S-band and an X-band payload will be included besides the backup UHF. The CCSDS-compatible S-band communication link will act as the main link for data communications and will provide uplink speeds of up to 256 kbit/s and downlink speeds of up to 1 Mbit/s. An X-band payload for downlink only will provide high-data-rate communications of up to 50 Mbit/s. This paper reports on the design and the prototype development of the S-band and X-band communication antennas. As the final S-band and X-band frequencies are still to be defined, prototypes have been developed with resonance frequencies of 2.2 GHz and 8.1 GHz, respectively. The antennas have been designed as microstrip patches with right hand circular polarization. The single X-band patch antenna is mounted on the 10 cm x 10 cm nadir looking face of the triple unit CubeSat. A pair of S-band patch antennas is mounted on opposite sides of the cuboid facing the astronomical horizon. The design of the antennas as well as their position on the satellite structure have been simulated and enhanced with 3D electromagnetic solver software. The results have been verified by placing the antenna prototypes on a full size satellite mock-up and measuring the far field pattern in an anechoic chamber. The study reports on the communication capabilities of the antennas in the light of constraints and requirements of CubeSat missions. The study further compares simulation- and measurement results and discusses the influence of the CubeSat structure.