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Abstract

The Exploratory In-orbit Verification of an E-band link (EIVE) CubeSat project has the goal to launch a 71-76 GHz E-band transmitter as a technology demonstration mission into outer space.
The demonstration of the feasibility of a link in the E-band radio frequency spectrum is of major interest due to the ability to transmit data at high rates of multiple GB/s. Thus, this technology has the potential to advance the abilities of broadband data links and could boost 5G and satellite internet capabilities. However, just as laser communication, the influence of rain loss degrades the performance of radio links at high carrier frequencies. Therefore, the EIVE mission wants to investigate the effects of the link geometry and the influence of atmospheric attenuation on the link characteristics. The E-band transmitter can handle pseudo-random bit sequences, sent in different modulation formats and transmission rates. Additionally, it can transmit real data and an uncompressed 4K live video stream to the ground station at the University of Stuttgart. The EIVE project started in 2019 and is currently scheduled for launch in October 2022.
The driving factor behind many of the design decisions of the satellite platform are the specific requirements of the E-band transmitter payload, especially in terms of power consumption, thermal dissipation and pointing accuracy. Furthermore, the 6U CubeSat size poses a major constraint and imposes challenges regarding the accommodation of the E-band transmitter as well as the equipment necessary to operate it. This paper introduces the design of the EIVE satellite and shows how these challenges were managed. The conduct tests and the results of the verification campaign are presented in this paper. During functional testing, the satellite is brought into the modes of operation where the software, data handling, and power consumption are monitored. Special attention is paid to the attitude control tests. These include measuring the magnetic dipole moment of the satellite, calibrating the magnetometers within the self-developed Helmholtz test cage, and stimulating the sun sensors and the star tracker, among other tests. The EIVE CubeSat must be compliant with the IRS ground station as well as the GSOC/DLR ground stations. Thus, end-to-end tests with the S-band telemetry and telecommand system are conducted to show that both the physical and the data connection are working. Finally, thermal vacuum and vibration testing proof the thermal and mechanical design.

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