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C6 STARS: A SCALABLE 256-ELEMENT PHASED ARRAY FOR NANO SPACECRAFTS

Abstract

After successfully concluding a Canadian Space Agency (CSA) technology development project, C6 Launch Systems has designed, built and tested a scalable phased array that allows spacecrafts electronically steer their radio beams at earth and space-based stations to provide high-performance data links. The integrated system occupies a Cubesat volume of 0.25U employing an integrated transceiver, an up-down converter and a chain of beamforming circuits to manage the phase and gain its elements. The array's elements are slot coupled microstrip antennas etched on an asymmetric PTFE substrate stack having a 10dB impedance bandwidth of 900MHz, with a maximal 25dB return loss at 24GHz. Circular polarization is made possible by using a cross slot geometry. The system is scalable, low-power, lightweight and made from commercially-off-the-shelf components requiring 0.5W for each 16-element at maximum gain. The technology is used at a static launch vehicle test at NASA's John Stennis Space Center and its maiden flight is planned to be on the C6 launch vehicle in 2021. Link budget estimates show that integrating the developed phased array with an upcoming commercial space data-relay system, having an Equivalent Isotropic Radiated Power (EIRP) and gain-to-noise-temperature (G/T) of 41.5dBW and 4.7dB/K, results in improved data links compared to omnidirectional antennas from launchpad to low earth orbit. Presented in this paper is the background and systems design information of the scalable phased array antenna. This paper also demonstrates the system's usage and performance at the static integrated launch vehicle test and in conjunction with the space-based data relay system.