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PERFORMANCE TESTING OF A 256-ELEMENT PHASED ARRAY AT DAVID FLORIDA LABORATORY

Abstract

Although, nanosatellite capabilities are improving, the dilemma of affordable high bitrate communication poses a burgeoning challenge for operators. Rigidifying ITU regulations and sharing limited spectrum resources are the biggest contributors to this predicament. Historically, satellites have opted for phased arrays to enhance communications with relay stations, however, legacy phased array systems require plentiful discrete components resulting in large form factors, high power requirements and unsuitable costs for atypical nanosatellite. As such, a Cubesat compatible 256-element phased array prototype has been developed from a Canadian Space Agency (CSA) project. This paper presents 3D radiation pattern test procedures and results obtained at David Florida Laboratory (DFL). The overall system is relatively small compared to traditional satellite phased array systems, thus distinct consideration and calibration methods were utilized to obtain the 360X360 radiation pattern while minimizing the measurement sphere that encompasses the phased array in the anechoic chamber. The phased array occupies less than 0.25U employing a highly integrated transceiver, a super-heterodyne up-down converter and a synchronized chain of beamforming integrated circuits to control and measure the phase and gain of its elements. The array's elements are comprised of aperture coupled patch resonators constructed on an asymmetric PTFE laminate stack and have a 10dB impedance bandwidth of 900MHz, centered at 24GHz. Beamsteering functionality is also demonstrated with pointing accuracy, tracking rate and pointing range compared with MATLAB simulations. Deviations as a result of element routing difference, impedance mismatch and other factors are explained with array calibration demonstrated to eliminate the deviations.