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NRD Waveguide Rotation Nodes for Spacecraft Communication Devices

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Abstract. Nowadays, in space equipment, the requirements for the characteristics of communication systems are becoming stricter, which is reflected in the need to design functional units of the microwave range with low weight and size characteristics and a high efficiency. Minimizing the dimensions of spacecraft themselves requires electromagnetic wave channeling nodes to have a technical ability to bend and rotate in order to save space or use nodes in rotation mechanisms. This work is devoted to the study of the physical phenomena and characteristics of rotation nodes based on the non-radiative dielectric (NRD) waveguide as well as the identification of recommendations for their use in spacecraft and communication systems in the topological and normal planes. As part of the study, the scattering matrix of various rotation and bend structures was analyzed based on the NRD waveguide. Materials with a different permittivity suitable for the 3D printing technology were used to identify the patterns and analyze the characteristics of the nodes. The results of the study were obtained using numerical methods and a physical experiment on a mock-up of an experimental setup. The recommendations obtained can be employed in the design of adjustable rotation modules when designing NRD waveguides in space communication devices.

Keywords: wave propagation, NRD waveguide, waveguide rotator, microwave technology
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