Low profile dual-pol isoflux antenna based on artificial impedance surface

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Antennas for data downlink (DDL) from LEO satellite require an isoflux-shaped radiation pattern, with demanding requirements in terms of gain smoothness and ripple and phase linearity. Furthermore, next generation antennas shall be able to work in dual polarization, in order to increase the channel capacity, and to handle around 100W per channel. Finally, thermo-mechanical aspects of the design acquire a significant relevance in order not to compromise the antenna performance when operating in orbit. Innovative antenna solutions are required to fulfill all these specifications.

This paper presents an innovative DDL antenna configuration based on an artificial impedance concept. The artificial impedance is implemented by annular concentric corrugations realized on a planar surface, fed by a low profile central feed. The antenna was developed in the framework of the project entitled "Medium-to-high gain X-band antenna with customizable pattern and polarization", funded by the European Space Agency (ESA) as part of the GSTP Program. The antenna design was performed by Wave Up through a proprietary Body-of-Revolution (BoR) code. The design procedure involved three steps: first, an optimization was made by exploiting an equivalent impedance model. Then, the equivalent impedance profile was implemented through corrugations. Finally, the resulting structure was used as a starting point for an optimization procedure based on full-wave BoR analysis.

A prototype has been constructed and experimentally characterized to verify RF performances. Measured results are in excellent agreement with simulations. The antenna operates in the X band, between 8075 and 8325 MHz, with a gain ripple smaller than 0.6dB, a phase ripple smaller than 2°, a pattern compliant with the isoflux mask and cross-pol isolation better than 15dB. The antenna has also passed preliminary environmental testing (electrical, mechanical and thermal) to verify the suitability of the critical design elements.

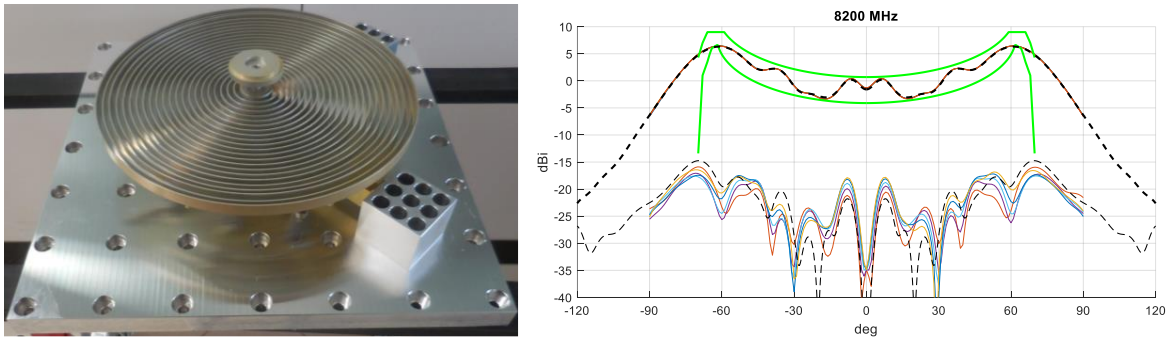

Figure 1. Picture of the realized prototype and relevant measured and simulated radiation patterns at 8200 MHz.