SDC – mmWave Multi-Beam 3D-printed Antenna Design

Detailed description and rules

Introduction

This competition will require students to design and manufacture a dual-beam linearly-polarized mmwave antenna using additive manufacturing/3D-printing techniques, with maximum gain in the band n257 (26.5-29.5GHz). The designs will be judged based on the gain performance of the antennas.

Design specifications and rules

Participants must design a dual-beam linearly-polarized passive antenna boresight in the n257 (26.5-29.5GHz) band with maximum gain in azimuth angles +30deg and -30deg from boresight and minimum gain at boresight. The antenna must be manufactured as a single body using only 3D printing/additive manufacturing techniques, and include a 2.92mm coaxial female/jack connector to perform measurements. The antenna cannot be manufactured as multiple independent parts that are assembled together. There is no material set restriction (metal, plastic or ceramic materials are all acceptable). Post processing of the material, such as surface polishing, or metal coating/plating is allowed. The antenna maximum dimensions and weight will be constrained by the antenna test chamber and positioner system (Maximum DUT size: 40mm x 200mm x 110mm, Maximum DUT weight 3kg). The aperture of the antenna (radiating portion, not mechanical portion) must fit within a circumference of diameter 83mm. The coordinate system will be established by the positioner.

Participants may fulfill the 2.92mm coaxial connector requirement by means of a passive commercial waveguide-to-coaxial adapter. The 3D-printed antenna, including the coaxial adapter provided by the participant, must incorporate all necessary features to mount it into the Millibox antenna test system. A standard CAD file for the Millibox mount will be provided. **Participants are required to contact the organizers before starting to design the antenna in order to receive this CAD and other relevant data related to the orientation of the antenna.**

Evaluation process

Each participating design will be assembled into the Millibox anechoic chamber. The gain of the antenna will be measured at boresight, +30deg and -30deg from it in the azimuth plane in the n257 (26.5-29.5GHz) band. These measurements will be summarized in a total score, as described in the next section.

Scoring

Gain will be measured at 3 frequency points (26.5, 28 and 29.5GHz) in all 3 directions (azimuth 0, +30deg, -30deg) and rounded to the nearest 0.1dB. The gain values at +30deg and -30deg will be summed together, and the gain values at boresight (azimuth 0 degrees) will be subtracted to create the total score. The design with the highest total score will win the competition.

An example of scoring for a representative antenna is included below:

Example measured values:

26.5GHz: Az=+30deg -> Gain=10dB;	Az=0deg -> Gain=-1 dB;	Az=-30deg -> Gain=8dB
28.5GHz: Az=+30deg -> Gain=10.5dB;	Az=0deg -> Gain=-0.5dB;	Az=-30deg -> Gain=8.5dB

29.5GHz: Az=+30deg -> Gain=11dB; Az=0deg -> Gain=0dB; Az=-30deg -> Gain=9dB

Total Score=58.5 [(11+10.5+10)+(9+8.5+8)-(0-0.5-1)]

Equipment information

This competition will require a small anechoic chamber to perform measurements (Millibox benchtop antenna test system) with a standard horn antenna, cables with male 2.92mm connectors, a network analyzer capable of measuring 2-port S-parameters in the range 26-30GHz, power and power cables for the chamber positioner and network analyzer, a table and chairs, and whiteboard to display scores.

Name and number of supporting MTT-S Technical Committee

- MTT TC-16 Microwave and Millimeter-Wave Packaging, Interconnect and Integration Committee
- MilliBox Antenna Test Systems

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