A Configurable Coupling Structure for Broadband Millimeter-Wave Split-Block Networks

In order to realize series-fed millimeter-wave hollow waveguide array antennas, small slots or holes can be used to couple a defined amount of power from the main feed line to the radiating elements. Due to the small size of these structures, they are challenging to manufacture. Moreover, if the size of the required slots or holes are smaller than the available drill, they are not realizable at all. This paper describes a coupling structure, which uses laser-cutting to realize a small slot, while all the other parts of the waveguide circuit can be milled in split-block technology. A deployment in harsh environments such as fusion experiments is feasible, as the whole structure can be built from metal. By design, it is possible to configure the coupling slots, and thus, adjust or modify the tapering of the array antenna. A theoretical model of the proposed structure is given and measurements of $W$-band prototypes are presented. The manufactured slots achieve coupling factors ranging from $-24.2$ dB to $-9.4$ dB. Measurements prove the applicability of the proposed design in broadband feed networks as the coupling values are nearly frequency independent with a deviation from the mean coupling ranging from $0.6$ dB to $0.9$ dB in the whole $W$-band. The maximum phase variability between the evaluated slots is $10$ dB.