High-Power Scanning Waveguide Array

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Abstract

Microwave antennas for hypoband (narrow band) operation are a well-established subject. For high-power application, with electric fields approaching breakdown in various media of interest, the subject is less well established. However, some basic techniques for radiating high-power microwaves (HPM) have been published in several papers. These have been summarized in a book. [C. D. Taylor and D. V. Giri, *High-Power Microwave Systems and Effects*, Taylor & Francis, 1994] Among other things, these give techniques and canonical designs for HPM antennas systems (including waveguides) for pyramidal-horn fed reflector antennas for both high power and high gain. While these are quite appropriate HPM radiators, it is useful consider other possible types for their advantages/disadvantages.

Array antennas, while more complex, have the advantage of having less depth (and hence less volume) for the same total antenna aperture, and hence similar potential antenna gain. A common form of an array is formed by a set of slots in one or more rectangular waveguides. (However, small holes are not appropriate for high power transmission through them.) Using the dispersive character of the lowest order waveguide mode ($H_{1,0}$) one can steer the antenna beam by changing the microwave frequency. Other types of guiding structures (e.g., dielectrics) have also been used for this purpose. However, for frequencies around a GHz the large size of the waveguide suggests that for low mass a hollow metal pipe has certain advantages.

In [C. E. Baum, "Some Features of Waveguide/Horn Design", Sensor and Simulation Note 314 (section VI), 1988] I have discussed the division of a rectangular waveguide into a set subguides by insertion of metal sheets parallel to the broad wall (and perpendicular to the electric field of the $H_{1,0}$ mode) inside the waveguide and connecting to the side (narrow) walls. There, among other things, I suggested that this technique could be used to divide the power in the waveguide into N subguides which could be used to feed N array elements. The present paper expands on this in one form of such an array.