Analysis of a Coaxial Cavity with Cross-Section Dependent upon Axial Displacement

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The field in a cylindrical cavity, comprising cascaded coaxial and circular-cylindrical sections, may be computed by expanding the field in each section in terms of the eigenfunctions of that section and enforcing continuity of the tangential field in the apertures in the planes at which the sections join. When a section's cross-section varies with axial displacement, the eigenfunctions of the section may not be known and, hence, another method must be devised to determine the field in that section. If the cavity is composed of a combination of sections with fixed cross-sections and sections with variable cross-sections, then the eigenfunction expansions may still be used to determine the fields in the fixed cross-section cavities.

In this paper, aperture theory is employed to determine the field in a cavity section with variable cross-section which is excited by the field in a sending-end uniform coaxial section and which is terminated by means of a receiving-end uniform coaxial section. In the usual way, the apertures are shorted and an equivalent magnetic current (related to the electric field in the aperture) is placed on the shorted apertures. Next, the pec walls of the cavity are removed and an equivalent electric current is placed on the surfaces formerly occupied by the walls. If this new (wall) surface (original walls plus shorted apertures) is a closed surface, then either the EFIE or the MFIE may be incorporated in the solution technique, but, if surface is not closed, e.g., the modeled wall has a baffle, only the EFIE is applicable. From the coupled integral equations formulated to satisfy boundary conditions, sending-end excitation, and receiving-end termination, one determines wall current and equivalent magnetic current (or aperture electric field), and, from these quantities, the cavity field can be readily found.

The time-harmonic integral equations, whose solutions may be used to compute all other quantities of interest, are solved numerically. For specified input signals and receiving-end terminations, the time history of reflection at the input and transmission to the receiving end are determined from frequency-domain data and the FFT. Models have been fabricated and experiments were conducted for a number of cavity configurations. Measured data allow one to corroborate computed values of quantities of interest. Computed and measured results are in very good agreement.