Design and Simulation of a Mode Converter for the Excitation of Quasi-Optical Amplifiers

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Quasi-optical amplifiers, which occupy a cross-sectional dimension much greater than $\lambda/2$, provide a solution for efficiently combining the power output of many devices [1]. In order to excite quasi-optical amplifier efficiently, we have to obtain a uniform transverse electromagnetic (TEM) field distribution at input and output. Previous researchers have studied various approaches to obtain TEM-mode such as hard horn feeding [2] and photonic crystal walls [3]. It is convenient if we can feed the amplifier from standard waveguide, but one must have a means for converting between a standard waveguide and a large cross-section overmoded guide with uniform field distribution.

This paper presents simulations of structures aimed at distributing the power from a standard TE_{10}-guide onto a larger square aperture, increasing both the height (E-plane) and width (H-plane) of the guiding structure. The E-plane transition is, in a strict sense, a power splitting structure which couples the energy input from a standard TE_{10} waveguide into four TE_{10} waveguides through specially designed irises. The field distribution in those waveguides should be equal in phase and magnitude at the output reference plane. They are then combined together to form the required height transition by terminating adjacent waveguide walls a quarter wavelength away from the coupling holes. The simulated field distribution is uniform in the E-plane and sinusoidal in the H-plane. The H-plane transition is composed of two sections of rectangular waveguides that increase the guide width from standard width to 1.5 λ in two steps. The size of the steps and their placement along the direction of propagation are critical in order to obtain uniform power and phase distributions. The overall length of the H-plane transition is $3/4\lambda$. The field distribution across the 1.5λ mouth of the H-plane converter is uniform to within 3dB across 75% of its width, and within 6dB across 85% of its width.

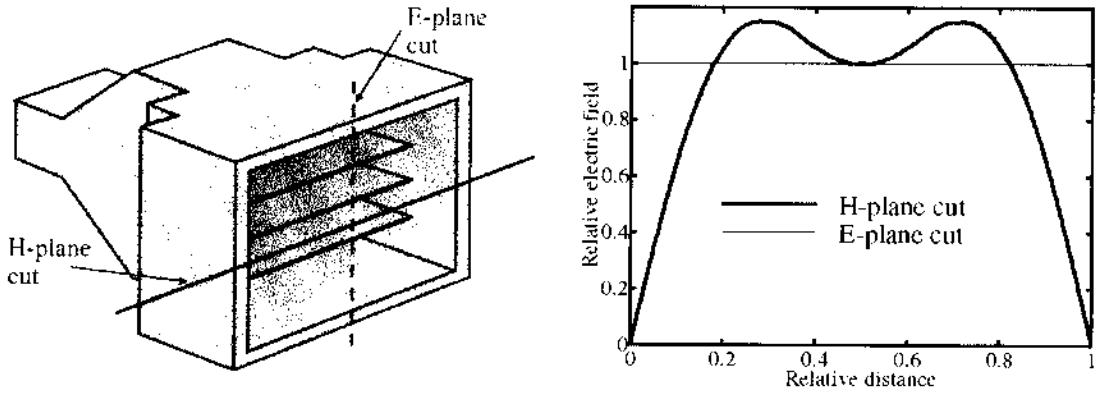

Figure 1. Transition to overmoded waveguide and simulated electric field

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References

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