Abstracts

Delay Equalization by Tapered Cutoff Waveguides

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When a wave packet propagates in a guided mode subject to cutoff at a definite frequency, dispersion is always present. To restore the shapes of the wave packets at the receiving end, a proper delay equalization must be applied. Waves propagating in a waveguide tapered to cutoff dimensions are reflected mostly in a region where the dimensions are at cutoff. Accordingly waves of higher frequencies will penetrate deeper into the tapered guide and thereby introduce more delay than those of lower frequencies. A profile of a tapered waveguide is obtained for the case of linear delay on the hypothetical assumption that a wave is totally reflected only at the plane of cutoff dimensions. The problem of finding a proper profile is similar in nature to the inverse scattering problem in quantum mechanics. The complex input reflection coefficient introduced by a tapered cutoff waveguide is invariably unity in its magnitude for all frequencies below cutoff and has different phases for different frequencies. Presently available theory for computing the complex reflection coefficient is valid only when its magnitude is smaller than unity. A theoretical method to calculate with accuracy the phase of such unity reflection coefficient is presented. The linking section between the standard waveguide and the tapered cutoff waveguide is designed on the basis of a high-pass filter that introduces no appreciable perturbation to the prescribed delay characteristic. The excellent agreement between the theoretical results and measured data suggests that microwave delay equalizers can be designed "on paper" with "measurement" accuracy without even going to the laboratory. Accordingly the claim can be made that any reasonable amount of delay of simple shape within certain bandwidth limits can be equalized by the present approach.

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