Abstracts

Nonuniform Waveguide High-Pass Filters with Extremely Steep Cutoff

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The design of a tapered waveguide high-pass filter with very steep cutoff characteristics near the cutoff frequency and very low reflections for frequencies beyond the cutoff is studied on the basis of nonuniform or inhomogeneous transmission line theory. The complex input reflection coefficient due to the presence of a section of nonuniform waveguide is obtained through a new approach by formulating the problem in terms of a pair of coupled differential equations of forward wave and reflected wave with varying propagation constants and nonuniform coupling coefficients. The solution of the reflection coefficient appears in the form of an infinite series of integrals and can be reduced, for the case of very gentle tapering to the simple form of fourier integral previously obtained by others. The general solution thus obtained is valid even if 1) the tapering along the waveguide is not gradual, and 2) the tapered section is terminated in an arbitrary impedance. It is shown that among many illustrated simple trial functions of impedance variation along the taper, the exponential function raised to cosine square yields reflection characteristics with the steepest rise near the cutoff and the lowest reflections for all frequencies beyond the cutoff. The steep rise near cutoff frequency is phenomenal, since, for example, at the nominal cutoff of 55 kMc the reflection reduces to about -50 db within 0.18 kMc, i.e., the transition region from the stop band to pass band at -50 db reflection is only about 0.33 per cent of cutoff. The same design procedure for the high-pass filter can be used for waveguide transitions of extremely wide band and very low reflections.

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