Foreword

NEW SYSTEMS continue to require microwave filters with ever more stringent passband and stopband control, smaller size, and lighter weight. Today's communications satellites, as an example, demand the tightest possible packing of channels in specific total bands. This requirement has stimulated especially sophisticated advances in insertion-loss and group-delay performance, more practical and compact configurations, and more versatile and useful theoretical design theory for bandpass two-ports and multiplexers.

About half of this special issue deals with communications satellite filters. For example, G. Pfitzenmaier's invited paper treats the general synthesis of low-pass prototypes for bandpass filters with Chebyshev reflection in the passband, and by means of nonadjacent couplings, rejection points in the stopbands and nearly constant group delay over most of the passband. The same response is achievable with many different arrangements of cross couplings. Pfitzenmaier's theoretical synthesis allows flexibility in the placement of the cross couplings, leading to bandpass filters with interesting, useful arrangements of cavities and input and output ports.

H. C. Bell, Jr., shows how to transform the usual symmetric canonical low-pass prototype into various asymmetric equivalents, some of which have configurational advantages similar to those of Pfitzenmaier's. Bell's most general prototype uses diagonal cross couplings to produce nonsymmetrical bandpass frequency response with arbitrarily unequal insertion-loss minima and numbers of rejections in the lower and upper stopbands. (His theoretical synthesis of this case is covered in an earlier paper.)

Dielectric resonators are now being used, because a material is available with excellent temperature stability, reasonably high permittivity of about 38, and high Q_u comparable to that of rectangular waveguide cavities. Although the $TE_{01\delta}$ mode in circular disks is usually employed, S. J. Fiedziuszko describes a filter that uses dual-mode cross-polarized $HE_{11\delta}$ resonances in dielectric disks centered in cavities within a cylindrical, in-line metal structure similar to that described by A. E. Atia and A. E. Williams in 1972 (*IEEE Trans. Microwave Theory Tech.*, vol. MTT-20, pp. 258–265). Nonadjacent couplings yield stopband rejection points. The use of the dielectric disks leads to a major reduction of size and weight compared to empty TE_{111} cavities at the same frequency. There is a moderate increase of passband dissipation loss, however, because Q_u for the dielectric resonator is somewhat less than that of an empty TE_{111} cavity.

Multiplexer designs are described by Rosowsky and Wolk and by Thal. Neither design is concerned with contiguous frequency channels; however, important information pertaining to electrical and mechanical design techniques is given. It should be noted that high-power design techniques are playing an ever-increasing role in broadcast and communications satellite systems.

Increasing use of microstrip circuits demands improved microstrip filters. A novel application by Giannini, Salerno, and Sorrentino uses two modes of resonance at different frequencies in a metallized rectangle on a microstrip substrate. By properly joining such rectangles together, elliptic-function low-pass filters can be achieved very compactly. An example is a seven-pole, elliptic-function, low-pass filter consisting of only three rectangles and the microstrip terminating lines.

Variable frequency tuning of microwave filters can be achieved by varying the center frequency and/or changing the bandwidth. The second approach is discussed by Hunter and Rhodes, with particular reference to the comb-line construction. Some alternative ideas are also proposed by Toyoda in a short paper. The search for different, and perhaps improved, ways of changing center frequencies, bandwidths, or characteristics of filters (or any combination of these techniques) would be a useful subject for further work.

The last two full papers describe filters employing inhomogeneous dielectric and multisection tandem stripline elements. Two short papers cover useful aspects of cavity filters.

Readers interested in microwave filters are advised to examine this issue carefully, as well as many papers previously published in this area. The bibliographies accompanying the articles will aid in locating these papers.

SEYMOUR B. COHN

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