NON-MINIMUM PHASE, OPTIMUM AMPLITUDE, BANDPASS WAVEGUIDE FILTERS

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Abstract

This paper describes the synthesis of narrow-bandpass waveguide filters having flat group delay and optimum amplitude characteristics. The design utilizes orthogonal-mode square waveguide cavities which lead to compact and lightweight filters.

Introduction

The design of narrow-bandpass waveguide filters having flat in-band group delay and a monotonic amplitude response has been described previously.[1,2] The filters to be described in this paper also have flat in-band group delay, but exhibit the more optimum elliptic-type amplitude response. These transfer functions are realizable in the orthogonal-mode square waveguide cavity geometry shown in Fig. 1. Such a structure leads to compact and lightweight filters.

Theory

The synthesis of a multicoupled cavity network from a low-pass transfer function of the form

$$t(s) = N(s)/D(s)$$

where $D(s)$ = Hurwitz polynomial of order n

$N(s)$ = polynomial of order $\leq n - 2$

$$|t(j\lambda)|^2 \leq 1, \quad -\infty < \lambda < \infty$$

has been described previously in References 3 and 4. The method used to reduce to zero some of the general matrix elements to arrive at the general orthogonal, coupled, square waveguide cavity structure of Fig. 1 has also been described.

Experiment

To illustrate the realization of these near-optimum filter transfer functions, a 12th-order low-pass function was chosen.[5] This transfer function has been realized by the filter shown in Fig. 2, which has a center frequency of 4 GHz and a 40-MHz bandwidth. The experimental results for the 6-waveguide-cavity filter are compared with the theoretical response in Figs. 3 and 4.

Conclusions

The realization of near-optimum, non-minimum phase functions in waveguide represents a significant improvement in filter characteristics over those obtained previously. Further, the orthogonal-mode form leads to very compact and lightweight filters.

References

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3. A. E. Atia and A. E. Williams, "New Types of Waveguide Bandpass Filters," COMSAT Technical Review, Vol. 1, No. 1, Fall 1971, pp. 21–41.

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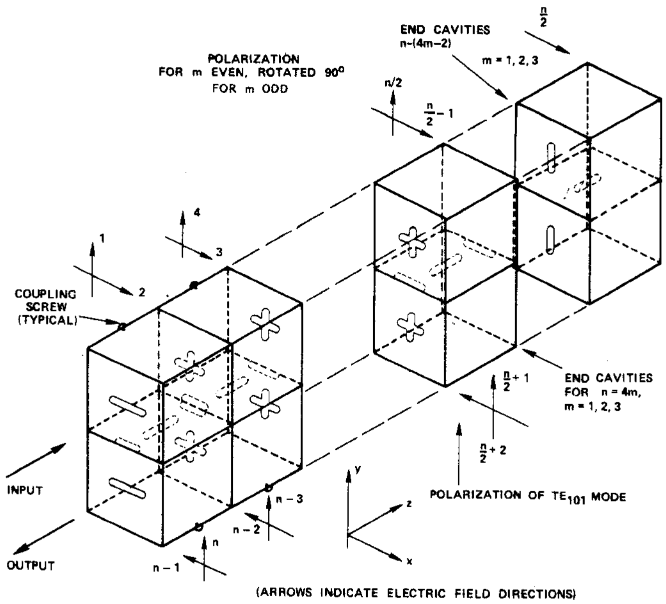

FIG. 1. ORTHOGONAL-MODE FILTER STRUCTURE

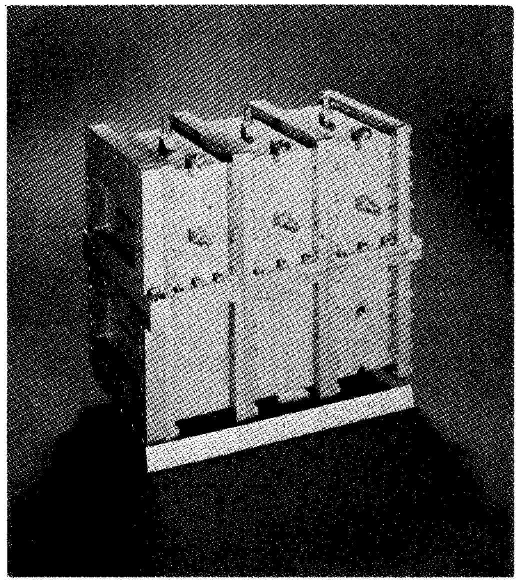

FIG. 2. EXPERIMENTAL FILTER

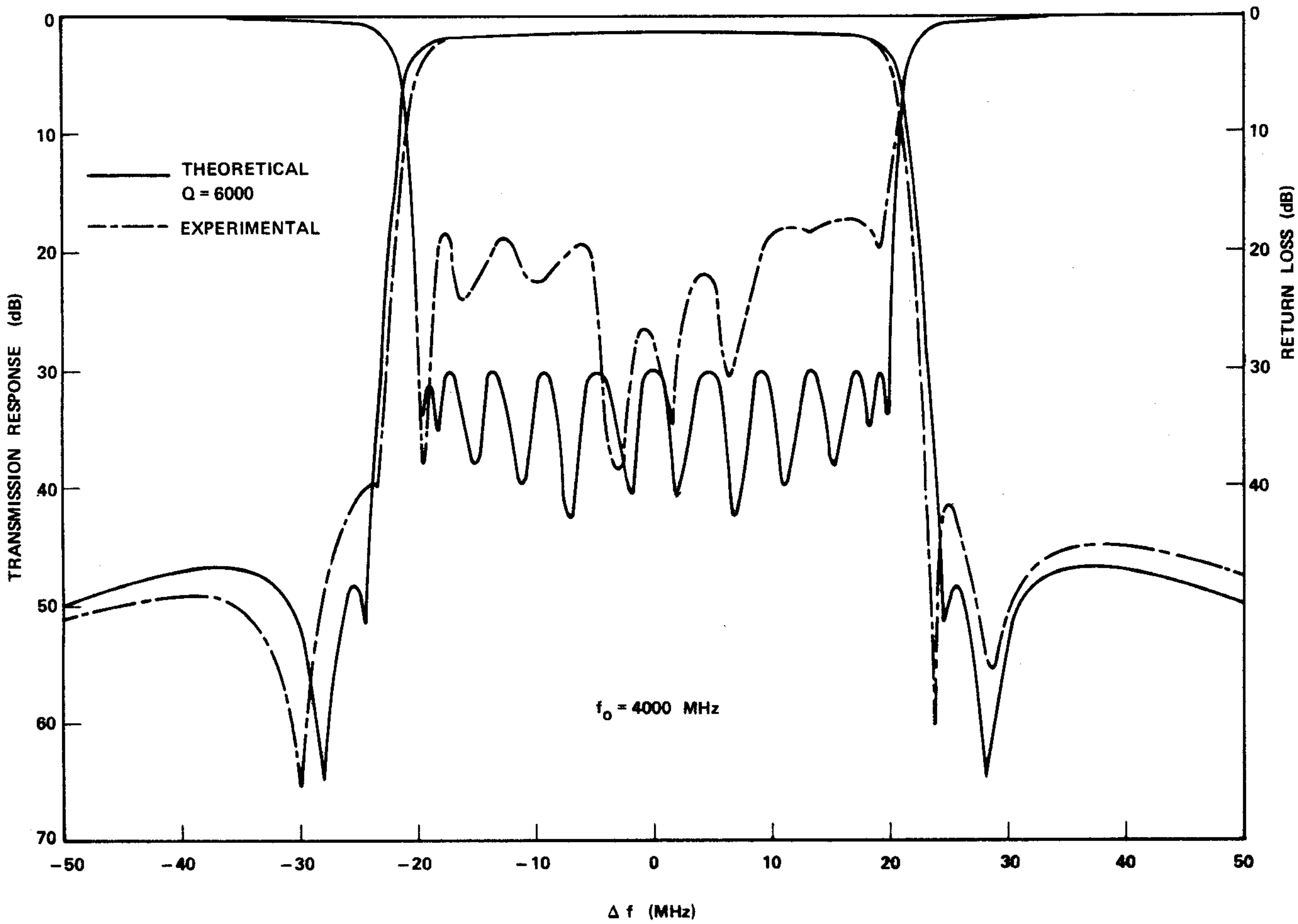

FIG. 3. TRANSMISSION AND RETURN LOSS

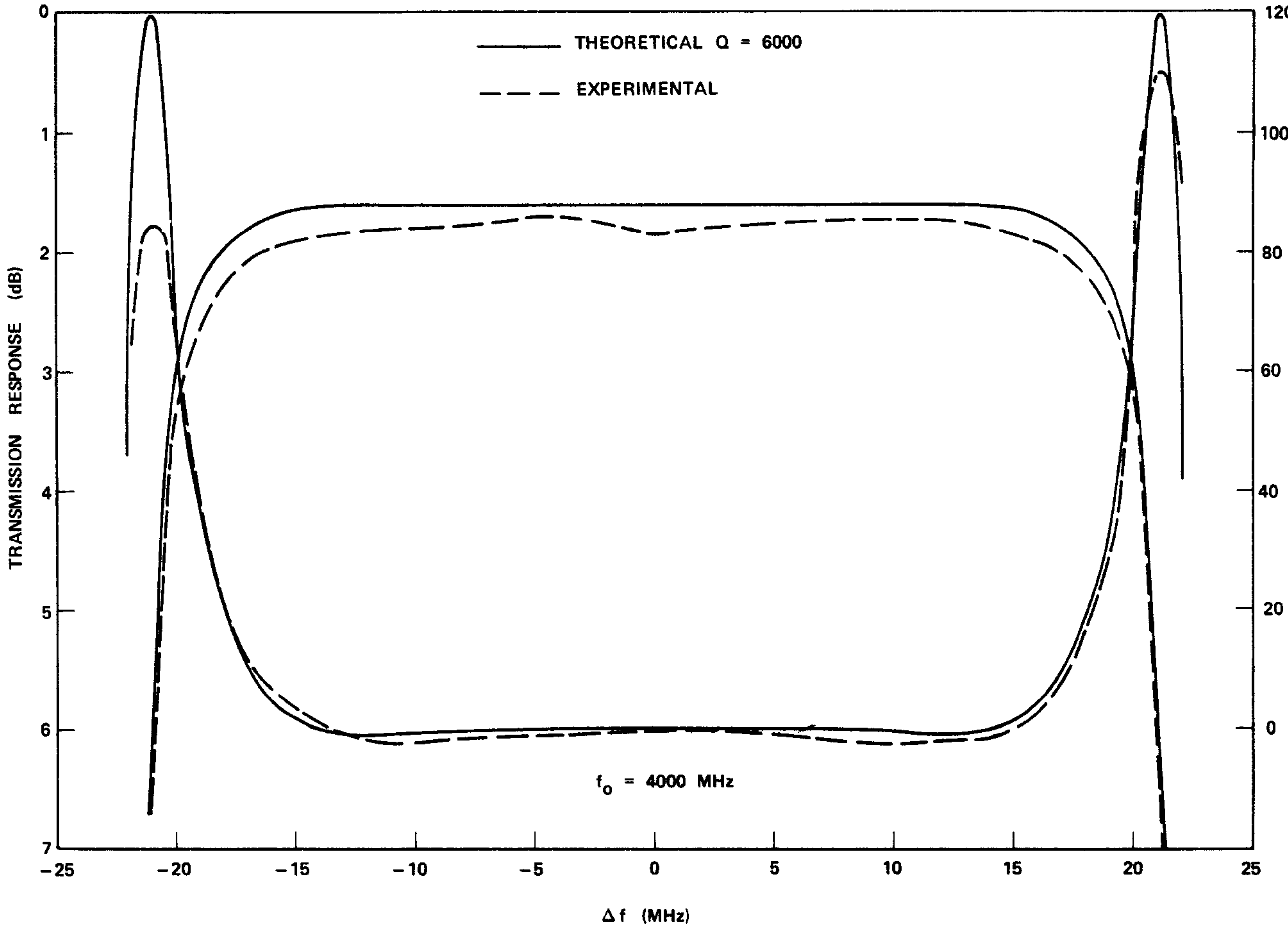

FIG. 4. IN-BAND RESPONSE AND TIME DELAY