it will still have values falling between these limits when multiplied by $Y_0^2R_0/4C'$. The new function will intersect the curve in Fig. 2 in $2n + 2$ points, and the difference between the new function and the equiripple function defines an even polynomial of degree $2n$ with $2n + 2$ zeros. Since this is clearly impossible unless $E_{n+1}'(t^2) = E_{n+1}(t^2)$, the conditions of the theorem characterize a unique, optimum transformer cascade which matches the specified reactively shunted load with equiripple performance and reflection coefficient zeros in the design band.

COMMENTS

One of the principal points of interest in this letter arises from the fact that this example shows that an integral condition on the logarithm of the absolute value of the reflection coefficient like [1, eq. (58)] cannot be used to argue that in an optimum match to a reactively loaded load, one must avoid reflection coefficient zeros in the design band. The situation here for distributed matching networks should be compared to that for lumped constant networks discussed extensively by Fano [3].

The argument used in the proof of the theorem is very similar to that which one would use to prove that the Chebyshev polynomials provide the solution to the problem of approximating $2^{n-1}x^n$ as closely as possible to a polynomial of lower degree, a so-called Chebyshev problem [2]. In this case, however, the coefficient of the even function $t^{2n+2}/(1 + t^2)^n$, which is to be approximated, is not fixed by the class of networks to be considered, with the consequence that we are not dealing with a true Chebyshev problem. Nevertheless, since all the networks of the permitted class result in a larger, leading coefficient than is associated with the network which provides the behavior required by the Chebyshev criterion, a proof that it is optimum can still be constructed. It may be of future interest to refer to such a problem as quasi-Chebyshev problem.

It should also be noted that similar remarks apply to the dual network in which the termination consists of a resistance in series with a capacitive stub.

REFERENCES

[1] H. J. Carlin and W. Kohler, "Direct synthesis of band-pass transmission line structures," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-13, pp. 283–297, May, 1965.
[2] N. I. Achieser, *Theory of Approximation*. New York: Ungar, 1956, pp. 51–58.
[3] R. Fano, "Theoretical limitations on the broadband matching of arbitrary impedances," *J. Franklin Inst.*, vol. 249, pp. 57–83, 139–154, Jan.–June, 1950.

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Robert Davies was born in Cardiff, Wales, on September 15, 1938. He received the B.Sc. degree in electrical engineering from the University College of South Wales and Monmouthshire, Cardiff, in 1959, and the Ph.D. degree from Queens University of Belfast, Belfast, North Ireland, in 1964.

He joined Mullard Research Laboratories, Redhill, Surrey, England, in 1963, and has since been engaged in the characterization and application of microwave semiconductor devices. He now leads a group concerned with the use of microwave semiconductor devices in circuits and subassemblies involving microwave integrated circuit (MIC) parametric amplifiers, transistor and FET low-noise amplifiers, transistor power amplifiers and frequency multipliers, TRAPATT oscillators, frequency-stable sources, and ferrite-diode limiters.

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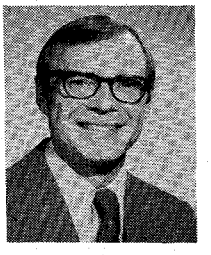

Carl H. Durney (S'60–M'64) was born in Blackfoot, ID, on April 22, 1931. He received the B.S. degree in electrical engineering from Utah State University, Logan, in 1958, and the M.S. and Ph.D. degrees in electrical engineering from the University of Utah, Salt Lake City, in 1961 and 1964, respectively.

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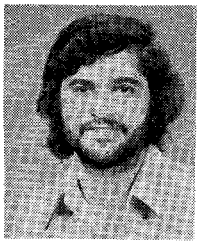

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Robert A. Gough was born in Northampton, England, on April 17, 1949. He received the B.Sc. (Honours) degree in electronic engineering from the University of Leeds, Leeds, England, in 1970, and the Ph.D. degree from the University of Bradford, Bradford, Yorks., England, in 1973 for work on varactor-tuned Gunn oscillators.

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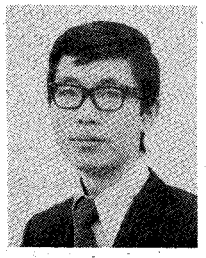

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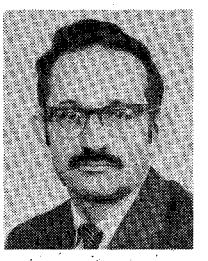

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Between 1954 and 1956 he served as a Technical Officer in the Israel Defense Army, and later as an Electronics Engineer engaged in design of digital circuits. He joined Sylvania's Applied Research Laboratory in 1964 and was engaged in laser modulator research. In 1965 he joined the Applied Research Division of Honeywell Information Systems, Waltham, MA. There he studied problems of high-speed pulse propagation on transmission lines, magnetic design of plated wire memories, etc. Between 1966 and 1971 he was Director of the Optical Mass Memory program at Honeywell Information Systems. In 1971 he joined the Department of Electrical Engineering of Tufts University, Medford, MA. He has been a Consultant to Honeywell and a number of industrial organizations in the Boston area.

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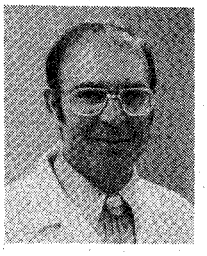

James L. Lords was born in Salt Lake City, UT, on April 5, 1928. He received the B.S., M.S., and Ph.D. degrees from the University of Utah, Salt Lake City, in 1950, 1951, and 1960, respectively.

From 1960 to 1962 he served as a Postdoctoral Associate at the University of Wisconsin, Madison. In 1962 he returned to the University of Utah as Assistant Professor of Experimental Biology. He worked on problems related to thermophilic organisms. As a natural consequence of his interest in thermophilly, he became involved in the effects of electromagnetic radiation, particularly the microwave region of the spectrum, on biological systems. He is currently a Professor in the Department of Biology, where he is engaged in the teaching of Physiology and in research on the effects of microwaves on the physiology, biochemistry, and behavior of organisms.

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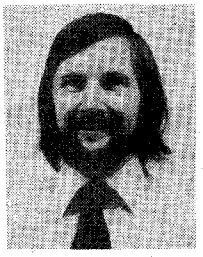

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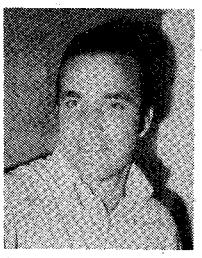

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