TABLE I

Element Number	Initial Electrical Length (Degrees)	Final Electrical Length (Degrees)
1	100.	49.139
2	100.	97.149
3	100.	74.658
4 (Transistor)	----	-------
5	100.	75.566
6	100.	133.061
7	100.	88.435
8 (Transistor)	----	-------
9	100.	60.446
10	100.	137.678
11	100.	63.337

Note: Initial and final element lengths for the 1–2 GHz amplifier.

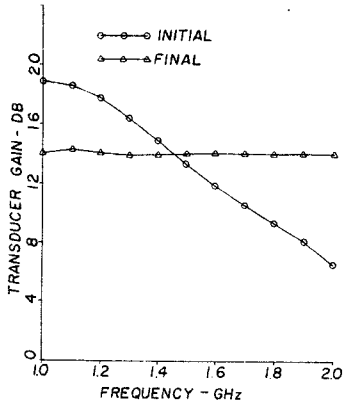

Fig. 2.

shown in Table I. All transmission line impedances were fixed at 50 Ω and only line lengths were allowed to vary. A value of $p = 4$ was selected for the least pth objective function. The frequency points were chosen as: 1.00, 1.25, 1.50, 1.75, and 2.00 GHz. The S parameters for the HP35831E transistors were obtained from the manufacturer's specifications.

After fifteen iterations or about 122 s of computer time, the program converged to the final parameter values given in Table I. Fig. 2 shows the frequency response of both initial and final designs. In order to obtain smooth curves, the responses at additional frequency points were calculated using MECAP [4]. The optimized response is 14 dB + 0.315 dB, −0.100 dB over the octave bandwidth.

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The authors wish to thank J. F. Gilmore and B. W. Leake of the Raytheon Company, Wayland, Mass., for transmitting a modified version of DEMON [5], part of which is used in the analysis routine of NOVA. The subroutine MATMUL, from Calahan [6], was also used in NOVA. Finally, the authors would like to acknowledge many helpful conversations with Prof. F. H. Irons of the University of Maine.

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Contributors

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Arthur W. Guy (S'54–M'57–SM'74), for a photograph and biography please see page 538 of the June 1975 issue of this TRANSACTIONS.

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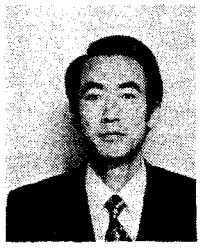

Takeshi Hatsuda (M'68) was born in Shimizu City, Shizuoka, Japan, on December 2, 1941. He received the B.S., M.S., and Ph.D. degrees in electrical engineering, all from the University of Hokkaido, Sapporo, Japan, in 1965, 1967, and 1974, respectively.

In 1967 he joined the Electrical Communication Laboratory, Nippon Telegraph and Telephone Public Corporation, Yokosukashi, Kanagawa, Japan, and is now a Staff Engineer of the Satellite Communication System Section. His research work since 1965 has been on the relaxation method for the solution of the electromagnetic field problem. Since 1967 he has been engaged in research on transmission line analysis and microwave integrated circuits, e.g., microwave transistor amplifiers and filters. From 1973 to the present he has been engaged in the research and development of system design for the lower millimeter-wave satellite communication systems.

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Since September 1966 he has been with the Electromagnetics Laboratory, University of Illinois. He has also been associated with the Coordinated Science Laboratory of the same university since August 1974. He is currently a Senior Research Engineer (with the rank of Associate Professor). During the academic year 1972–1973, he was appointed a Fellow of the Center for Advanced Study, University of Illinois. His research has been on electromagnetic theory, microwave techniques, optical communication, and numerical techniques.

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Reinhard H. Knerr (M'71–SM'73) was born in Pirmasens, Germany. He received the undergraduate degree from the Technische Hochschule, Aachen, Germany, in 1960; the Dipl. Ing. Degree from the National College of Electrical Engineering and Hydraulics, Toulouse, France, in 1962. He was then a Graduate Assistant, NATO Scholar, and finally full-time Instructor in the Department of Electrical Engineering, Lehigh University, Bethlehem, Pa., where he received his Ph.D. in 1968 on the topic of wave propagation in nonuniformly biased microwave ferrites.

From 1963 to 1965 he was concerned with the problem of plasma oscillations in solids. Since 1968 he has been a member of the Solid State Microwave Device Department of Bell Laboratories, Allentown, Pa. He has been involved in the design of lumped-element circulators, and IMPATT and microwave transistor amplifiers.

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James C. Lin (S'65–M'71), for a photograph and biography please see page 539 of the June 1975 issue of this TRANSACTIONS.

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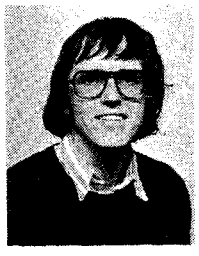

Kaj Madsen was born in Denmark in 1943. He received the cand. scient. degree in mathematics from the University of Aarhus, Aarhus, Denmark, in 1968.

He has been a Lecturer in numerical analysis at the Technical University of Denmark, Lyngby, since 1968, apart from the academic year 1973–1974, when he was at the Atomic Energy Research Establishment, Harwell, Didcot, England. His fields of interest in teaching and research are optimization and interval analysis.

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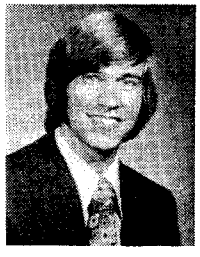

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Ole Nielsen (S'73) was born in Glostrup, Denmark, on May 22, 1949. He received the M.Sc. degree in electrical engineering in 1974 from the Technical University of Denmark, Lyngby.

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★

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In 1955 he became a full-time member of the Raytheon Research Division, Waltham, Mass., after having been employed on a part-time basis since November 1954. During the academic year 1961–1962 he served as a Visiting Associate Professor at the W. W. Hansen Microwave Laboratory, Stanford University, Stanford, Calif. In April 1964 he was advanced to the rank of Consulting Scientist in special recognition of his research achievements. In 1966 he served as a Visiting Professor at the University of Hamburg, Germany. He has published approximately 90 scientific papers, holds five patents, and has several patents pending.

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Upon completing his studies, he joined the Electromagnetics Institute, Technical University of Denmark, where he has been working with systems engineering and design of microwave filters. He is presently working towards a Ph.D. degree in electrical engineering.

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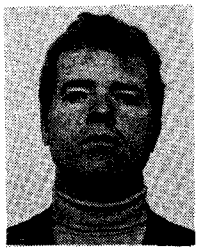

Robert J. Tiernan received the B.S. and M.S. degrees in physics from Boston College, Boston, Mass., and the Ph.D. degree in ceramics from the Massachusetts Institute of Technology, Cambridge.

He joined the Naval Research Laboratories, Washington, D. C., in 1959 where he set up an apparatus for measuring minority carrier lifetimes in semiconductors and determined the dependence of the structual and electrical properties of germanium thin films on evaporation parameters. In 1963 he worked in the Microelectronics Division at Sylvania Electric in Waltham, Mass., as a Senior Development Engineer. He was involved in setting up equipment for measuring resistivities, mobilities, and impurity concentrations of silicon thin-film devices. He also assisted in the development of improved electrical contacts to MOS and field effect devices. He joined the Raytheon Microwave Tube Operation, Waltham, Mass., in 1969 where he was involved in investigations of improved cooling techniques for high-power dissipation sources (specifically avalanche devices). He also worked on the development of improved attenuators and microwave windows for high-power tubes and doctor-blade techniques for ceramic substrates. Two years of his time at Raytheon were spent in the area of microwave ferrites, incorporating them into tubes and investigating their microwave loss performance near delay lines. He is employed at the Argonne National Laboratory, Argonne, Ill.

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