



# IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES

FEBRUARY 1980

VOLUME MTT-28

NUMBER 2

(ISSN 0018-9480)

A PUBLICATION OF THE IEEE MICROWAVE THEORY AND TECHNIQUES SOCIETY



---

## PAPERS

- Variational Treatment of the Diffraction at the Facet of d.h. Lasers and of Dielectric Millimeter Wave Antennas . . . *T. E. Rozzi and G. H. in't Veld* 61
- Transmission-Line Conductors of Various Cross Sections . . . *H. A. Wheeler* 73
- Propagation Along a Coaxial Cable with a Helical Shield . . . *D. A. Hill and J. R. Wait* 84
- Microstrip Transmission Line with Finite-Width Dielectric . . . *C. E. Smith and R. S. Chang* 90
- Coupled Microstrip Disk Resonators . . . *N. K. Uzunoglu and P. Katechi* 94
- Effects of Fringing Fields on the Capacitance of Circular Microstrip Disk . . . *W. C. Chew and J. A. Kong* 98
- Analysis of a Microstrip Covered with a Lossy Dielectric . . . *I. J. Bahl and S. S. Stuchly* 104
- Varactor Properties for Wide-Band Linear-Tuning Microwave VCO's . . . *D. F. Peterson* 110
- Coupled TEM Microstrip Impedance Transformer for S-Band TRAPATT Amplifiers . . . *S. K. Sinha and K. P. Weller* 119
- Techniques for Broad-Banding Above Resonance Circulator Junctions Without the Use of External Matching Networks . . . *G. P. Riblet* 125
- A Broad-Band Model for a Coaxial-to-Stripline Transition . . . *A. G. Chapman and C. S. Aitchison* 130
- Scattering and Mode Conversion of Guided Modes by a Spherical Object in an Optical Fiber . . . *N. Morita and N. Kumagai* 137
- A Theoretical Basis for Microwave and RF Field Effects on Excitable Cellular Membranes . . . *C. A. Cain* 142

---

## SHORT PAPERS

- Easy Determination of the Characteristic Impedance of the Coaxial System Consisting of an Inner Regular Polygon Concentric with an Outer Circle . . . *K. Tsuruta and R. Terakado* 147
- A K-Band Ruby Maser with 500-MHz Bandwidth . . . *C. R. Moore* 149

---

## LETTERS

- Comments on "Microstrip Characteristic Impedance" . . . *B. Bianco, M. Parodi, and S. Ridella* 152
- Response to Comments on "Microstrip Characteristic Impedance" . . . *W. J. Getsinger* 152

---

## COMPUTER PROGRAM DESCRIPTION

- Slot-Line Parameters . . . *H. J. Siweris* 153

- 
- CONTRIBUTORS . . . 154
-



# IEEE MICROWAVE THEORY AND TECHNIQUES SOCIETY

The Microwave Theory and Techniques Society is an organization, within the framework of the IEEE, of members with principal professional interest in the field of microwave theory and techniques. All members of the IEEE are eligible for membership in the Society and will receive this TRANSACTIONS upon payment of the annual Society membership fee of \$8.00. Affiliate membership is available upon payment of the annual affiliate fee of \$20.00. For information on joining write to the IEEE at the address below.

## ADMINISTRATIVE COMMITTEE

S. F. ADAM, *President*

F. J. ROSENBAUM, *Vice President*

G. R. BASAWAPATNA, *Secretary-Treasurer*

J. L. ALLEN  
J. C. AUKLAND  
B. E. BERSON  
K. J. BUTTON

\* *Ex officio (past presidents)*

J. E. DEGENFORD, JR.  
V. G. GELNOVATCH  
P. T. GREILING  
R. B. HICKS  
F. H. HOWE, JR.

R. H. KNERR  
H. J. KUNO  
S. L. MARCH  
H. G. OLTMAN, JR.  
D. PARKER\*

C. T. RUCKER  
H. SOBOLOFF  
R. A. SPARKS  
B. E. SPIELMAN  
L. R. WHICKER\*

## Honorary Life Members

A. C. BECK  
S. B. COHN

D. D. KING  
W. W. MUMFORD

A. A. OLINER  
T. S. SAAD

K. TOMIYASU

## National Lecturer

R. A. PUCEL  
J. WILTSE

## S-MTT Chapter Chairmen

Albuquerque: K. KUNZ  
Atlanta: D. W. HESS, JR.  
Baltimore: E. C. NIEHENKE  
Benelux (interim): J. AASTED  
Boston: W. A. DAVIS  
Canaveral: J. W. COFER  
Central Illinois: G. E. STILLMAN  
Chicago: D. R. SCHMIDT, JR.  
Columbus: R. J. MARHEFKA  
Dallas: J. W. WASSEL  
Delhi: P. P. WADHAWA  
Denver: C. T. JOHNS  
Florida West Coast: T. A. HAGLER  
Houston: W. L. WILSON, JR.

Huntsville: M. D. FAHEY  
Israel: Y. HIPSH  
Kitchener-Waterloo: Y. L. CHOW  
NY/Long Island: N. WORONTZOFF  
Los Angeles Council: H. J. KUNO  
Milwaukee: C. J. KOTLARZ  
Montreal: P. T. TAN  
NJ Coast: D. R. GUNDERSON  
North Jersey: H. GOLDMAN  
Orange County: J. C. AUCLAND  
Orlando: D. D. KHANDELWAL  
Ottawa: R. J. DOUVILLE  
Philadelphia: D. STAIMAN

Phoenix: R. S. JACOBSON  
Portland: P. P. FASANG  
Princeton: F. N. SECHI  
St. Louis: A. A. MADJAR  
San Diego: H. L. FALLER  
San Fernando Valley: H. POMERANZ  
Santa Clara V./O.-EB/SF: L. J. NEVIN  
Schenectady: T. G. MIHRAN  
Seattle: T. L. BLAKNEY  
S. E. Michigan: P. I. PRESSEL  
Syracuse: D. L. MATHER  
Tokyo, Japan: K. SUETAKE  
Washington, DC: R. KAUL

## IEEE TRANSACTIONS® ON MICROWAVE THEORY AND TECHNIQUES

### Editor

R. H. KNERR

H. G. OLTMAN, JR.  
(*Applications*)

### Associate Editors

B. PERLMAN  
(*Computer Program  
Descriptions*)

T. OKOSHI  
(*Abstracts Editor—  
Asia*)

Address all manuscripts to the Editor, R. H. Knerr, Bell Laboratories, 555 Union Boulevard, Bethlehem, PA 18103. Submission of three copies of manuscripts, including figures, will expedite the review. *Publication Policy:* All papers will be reviewed for their technical merit, and decisions to publish will be made independently of an author's ability or willingness to pay charges. Voluntary page charges of \$70 per printed page will be requested for papers of five pages or less. Page charges of \$100 per page are mandatory for each page in excess of five printed pages. Also, the MTT-S Administrative Committee has established a quota for the number of pages printed in each issue of this TRANSACTIONS whose costs are not defrayed by payment of page charges. Papers not covered by page charges may be delayed until space in an issue is available. The Editor can waive the quota requirement for exceptional papers or because of other extenuating circumstances.

## THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

### Officers

LEO YOUNG, *President*  
C. LESTER HOGAN, *Executive Vice President*  
BRUNO O. WEINSCHTEL, *Secretary*  
DONALD S. BRERETON, *Treasurer*  
THEODORE H. BONN, *Vice President, Publication Activities*

RICHARD J. GOWEN, *Vice President, Professional Activities*  
ROBERT E. LARSON, *Vice President, Technical Activities*  
BENJAMIN J. LEON, *Vice President, Educational Activities*  
LARRY K. WILSON, *Vice President, Regional Activities*

LAWRENCE K. ANDERSON, *Division IV Director*

### Headquarters Staff

ERIC HERZ, *Executive Director and General Manager*  
RICHARD M. EMBERSON, *Executive Consultant*

THOMAS W. BARTLETT, *Controller*  
DONALD CHRISTIANSEN, *Editor of Spectrum*  
JOSEPH D. CODISPOTI, *Staff Director, Public Relations*  
IVAN G. EASTON, *Staff Director, Standards*  
LEO FANNING, *Staff Director, Professional Activities*  
ELWOOD K. GANNETT, *Staff Director, Publishing Services*

PATRICIA LECH, *Staff Director, Field Services*  
NEIL D. PUNDIT, *Staff Director, Technical Activities*  
EMILY L. SIRJANE, *Staff Director, Corporate Services*  
CHARLES F. STEWART, JR., *Staff Director, Administration Services*  
JOHN F. WILHELM, *Staff Director, Professional Activities*

### Publications Department

H. JAMES CARTER, *Associate Staff Director*  
*Production Managers:* ANN H. BURGMAYER, CAROLYN E. FLOWITZ, GAIL S. FERENC\* ISABEL NARFA  
*Supervisor, Special Publications:* JOSEPH MORICATO  
*Associate Editors:* PRIJONO HARDJOWIROGO, PATRICIA H. NOIAN, KALLIF ZAPITI

IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES is published monthly by The Institute of Electrical and Electronics Engineers, Inc. Headquarters: 345 East 47 Street, New York, NY 10017. Responsibility for the contents rests upon the authors and not upon the IEEE, the Society, or its members. **IEEE Service Center** (for orders, subscriptions, address changes): 445 Hoes Lane, Piscataway, NJ 08854. **Telephones:** Headquarters 212-644 + extension. Information -7900. General Manager -7910, Controller -7748. Educational Services -7860. Publishing Services -7560. Region/Section Services -7750. Standards -7960. Technical Services -7890. IEEE Service Center 201-981-0060. Washington Office: Professional Services 202-785-0017. **NY Telecopier:** 212-752-4929. **Telex:** 236-411 (International messages only). Individual copies: IEEE members \$5.00 (first copy only), nonmembers \$10.00 per copy. Annual subscription price: IEEE members, dues plus Society fee. Price for nonmembers on request. Available in microfiche and microfilm. **Copyright and Reprint Permission:** Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limits of U.S. Copyright law for private use of patrons: (1) those post-1977 articles that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through the Copyright Clearance Center; (2) pre-1978 articles without fee. Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. For other copying, reprint or republication permission, write to Director, Publishing Services at IEEE Headquarters. All rights reserved. Copyright © 1980 by The Institute of Electrical and Electronics Engineers, Inc. Printed in U.S.A. Second-class postage paid at New York, NY and at additional mailing offices.