

IEEE Transactions

ON MICROWAVE THEORY AND TECHNIQUES



T. S. SAAD

Volume MTT-11

JULY, 1963

Number 4

Published Bimonthly

Dielectric Constant and Loss Tangent of Ferrites

Asymmetric Coupled-Transmission-Line Directional Couplers

Scattering of Surface Waves

Attenuation Constant of Lunar Line

Laser-Pumped Millimeter-Wave Ruby Maser

Re-Entrant and Wide-Band Hybrid Couplers

**PROFESSIONAL TECHNICAL GROUP ON
MICROWAVE THEORY AND TECHNIQUES**

IEEE PROFESSIONAL TECHNICAL GROUP ON MICROWAVE THEORY AND TECHNIQUES

The Professional Technical Group on Microwave Theory and Techniques is an association of IEEE members with professional interest in the field of Microwave Theory and Techniques. All IEEE members are eligible for membership and will receive all Group publications upon payment of the prescribed annual fee of \$4.00. Members of the American Physical Society and the Institution of Electrical Engineers of Great Britain may become affiliated with PTGMMT and receive all Group publications upon payment of the Affiliate fee of \$7.50 per year.

Administrative Committee

Chairman

D. D. KING

Vice Chairman

H. M. ALTSCHULER

B. D. AARON

R. W. BEATTY

A. C. BECK

S. B. COHN

R. C. HANSEN

Secretary-Treasurer

R. A. RIVERS

T. S. SAAD

G. SHAPIRO

K. TOMIYASU

E. N. TORGOW

R. D. WENGENROTH

S. W. ROSENTHAL

Honorary Life Members

G. C. SOUTHWORTH

A. G. CLAVIER

Editor

ROBERT W. BEATTY

PTGMMT Chapters

Albuquerque-Los Alamos
Baltimore
Boston
Buffalo-Niagara
Chicago
Columbus
Denver-Boulder
Detroit
Florida-W. Coast
Long Island
Los Angeles
Montreal
New York
Northern N.J.

D. C. Thorn
F. C. Ogg, Jr.
R. Tennenholz
A. G. Warrick
H. Zucker
Hsien-Ching Ko
A. J. Estin
J. E. Rowe
R. C. Aucremann
P. Lubbell
A. Clavin
F. G. R. Warren
S. Holland
R. S. McCarter

Omaha-Lincoln
Orange Belt
Orlando
Philadelphia
San Diego
San Francisco
Santa Ana
Schenectady
Seattle
Syracuse
Tokyo, Japan
Toronto
Washington, D.C.

A. R. Edison
C. E. Dunn
J. E. Tracy
H. B. Klippel
R. U. F. Hopkins
P. D. Strum
D. S. Sabih
C. B. Mayer
I. C. Peden
H. G. Totten
Hides Iwakata
J. L. Yen
J. A. Kaiser, Jr.

IEEE TRANSACTIONS on Microwave Theory and Techniques

Published by The Institute of Electrical and Electronics Engineers, Inc., for the Professional Technical Group on Microwave Theory and Techniques, Box A, Lenox Hill Station, New York 21, N.Y. Responsibility for the contents rests upon the authors, and not upon the IEEE, the Group, or its members. Individual copies of this issue may be purchased at the following prices: IEEE members (one copy) \$2.25, libraries and colleges \$3.25, all others \$4.50. Annual subscription price: nonmembers, \$17.00; college and public libraries, \$12.75.

Address all manuscripts to Robert W. Beatty, PTGMMT Editor, National Bureau of Standards, Boulder, Colo. Submission of three copies of manuscripts, including figures, will expedite the review.

COPYRIGHT © 1963—THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Printed in U.S.A.

All rights, including translations, are reserved by The Institute of Electrical and Electronics Engineers, Inc. Requests should be addressed to the Institute of Electrical and Electronics Engineers, Box A, Lenox Hill Station, New York 21, N.Y.