



IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES

OCTOBER 1971

VOLUME MTT-19

NUMBER 10

Published Monthly

PAPERS

- The Single-Cavity Multiple-Device Oscillator.....*K. Kurokawa* 793
- Optimum Noise Measure of IMPATT Diodes.....*H. A. Haus, H. Statz, and R. A. Pucel* 801
- A Monte Carlo Procedure for Potential Theory Problems.....*G. M. Royer* 813
- Junction Reactance and Dimensional Tolerance Effects on X-Band 3-dB Directional Couplers.....
.....*W. H. Leighton, Jr., and A. G. Milnes* 818

CORRESPONDENCE

- Varactor-Tuned Lumped-Element Circulators.....*J. Helszajn, D. Walker, and F. M. Aitken* 825
- Measurement of the Dielectric Constant and Loss Tangent of Liquids by the Transmitted-Reflected Wave Method in the Millimeter-Wave Range.....*H. Yamamoto and S. Ohkawa* 827
- A 10-GHz Single Sideband Modulator with 1-kHz Frequency Shift.....*P. G. Brooker and J. D. E. Beynon* 829
- Azimuthally Dependent Magnetostatic Modes in the Cylindrical Ferrites.....*M. Masuda, N. S. Chang, and Y. Matsuo* 834
- The Impedance and Scattering Properties of a Plane Annulus Surrounding a Goubau Line.....*E. S. Gillespie* 837

COMPUTER PROGRAM DESCRIPTIONS

- Higher Waveguide Modes by Positive Definite SOR.....*M. Beaubien and A. Wexler* 839

-
- CONTRIBUTORS..... 841
-



IEEE MICROWAVE THEORY AND TECHNIQUES GROUP

The Microwave Theory and Techniques Group 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 Group and will receive this *TRANSACTIONS* upon payment of the annual Group membership fee of \$6.00. Affiliate membership is available upon payment of the annual affiliate fee of \$16.00. For information on joining write to the IEEE at the address below.

ADMINISTRATIVE COMMITTEE

S. OKWIT, <i>Chairman</i>		A. CLAVIN, <i>Vice Chairman</i>		N. LIPETZ, <i>Secretary-Treasurer</i>
F. R. ARAMS	R. V. GARVER	J. B. HORTON	R. A. RIVERS	S. W. ROSENTHAL
R. W. BEATTY	G. I. HADDAD	M. C. HORTON	G. P. RODRIQUE	E. N. TORGOW
J. H. BRYANT*	R. E. HENNING*	D. B. LEESON	F. J. ROSENBAUM	A. WEXLER
H. W. COOPER		J. M. OSEPCHUK		L. YOUNG*

* *Ex officio (past chairmen)*

Honorary Life Members

A. C. BECK	A. G. CLAVIER	W. W. MUMFORD	G. C. SOUTHWORTH
------------	---------------	---------------	------------------

G-MTT Chapters

Atlanta	T. J. LYON	Houston	H. C. BOURNE, JR.	Phoenix	M. D. SIRKIS
Baltimore	B. A. SICHELSTIEL	Huntsville	F. ROUFFY	St. Louis	W. E. HORD
Boston	H. HOWE, JR.	Long Island	J. GOLDBERG	San Diego	D. G. KILLION
Buffalo	K. BAKER	Los Angeles	N. PELNER	San Francisco	P. M. LATOURRETTE
Chicago	J. MEIER	Milwaukee	R. W. LADE	Schenectady	J. B. UNDERWOOD
Columbus	R. T. COMPTON, JR.	Montreal	E. F. MORRIS	Seattle	F. P. CARLSON
Connecticut	R. MASTROIANNI	New Jersey	R. V. SNYDER, JR.	S. E. Michigan	C. P. TRESSELT
Dallas	D. N. BOWYER	New York	D. K. WAINEO	Syracuse	B. L. BOWLER
Denver	M. T. DECKER	Orange Co.	J. M. SCHUCHARDT	Tokyo, Japan	S. OKAMURA
Florida-W. Coast	B. E. SIGMON	Orlando	W. H. SCHAEDELA	Toronto	S. DIMITREWSKI
Foothills, Calif.	H. P. JOHNSON	Philadelphia	W. J. WILSON	Tucson	E. P. PIERCE
Fort Worth	L. J. LANGSTON	New Hampshire		Washington, D.C.	C. E. EDWARD

IEEE TRANSACTIONS* ON MICROWAVE THEORY AND TECHNIQUES

Editor		Associate Editors	
G. I. HADDAD	S. OKWIT (<i>Institutional Listings</i>)	F. G. R. WARREN (<i>Foreign Abstracts</i>)	J. W. BANDLER (<i>Computer Program Descriptions</i>)

Address all manuscripts to the Editor, F. J. Rosenbaum, Dep. Elec. Eng., Washington Univ., St. Louis, Mo. 63130. Submission of three copies of manuscripts, including figures, will expedite the review.

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Officers

JAMES H. MULLIGAN, JR., <i>President</i>	CLARENCE L. COATES, JR., <i>Vice President, Publication Activities</i>
ROBERT H. TANNER, <i>Vice President</i>	JOHN R. WHINNERY, <i>Secretary</i>
HAROLD CHESTNUT, <i>Vice President, Technical Activities</i>	RAYMOND W. SEARS, <i>Treasurer</i>

Headquarters Staff

DONALD G. FINK, <i>General Manager</i>	
JOHN L. CALLAHAN, <i>Staff Consultant</i>	CHARLES F. STEWART, JR., <i>Director, Member Services</i>
ELWOOD K. GANNETT, <i>Director, Editorial Services</i>	BETTY J. STILLMAN, <i>Administrative Assistant to the General Manager</i>
WILLIAM J. HILTY, <i>Director, Convention and Publishing Services</i>	RICHARD M. EMBERSON, <i>Director, Technical Services</i>
WILLIAM J. KEYES, <i>Director, Administrative Services</i>	EDWIN D. MACDONALD, <i>Conference Services</i>
JOHN M. KINN, <i>Director, Educational Services</i>	SAVA I. SHERR, <i>Standards</i>
LEON PODOLSKY, <i>Staff Consultant</i>	

Editorial Department

H. JAMES CARTER, <i>Managing Editor, Transactions</i>	
<i>Senior Editors:</i> ANDRÉE ABRAMOFF, ANN H. BURGMEYER, CAROLYNE ELENOWITZ, GAIL S. FERENC	
<i>Associate Editors:</i> NANCY B. BUDDE, HELEN S. GOLDMAN, MARY M. HALL, RUTH MELNICK, MARILYN SALMANSON, NANCY VIGGIANO	

IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES is published monthly by The Institute of Electrical and Electronics Engineers, Inc., 345 East 47 Street, New York, N. Y. 10017. Responsibility for the contents rests upon the authors and not upon the IEEE, the Group, or its members. This journal is available in either microfiche or printed form. Individual copies may be purchased at \$2.50 (first copy only) by IEEE members and \$5.00 per copy by nonmembers. Annual subscription price: IEEE members, dues plus Group fee. Price for nonmembers available on request. Abstracting is permitted with mention of source. All rights, including translation, are reserved by the IEEE. Requests for republication permission should be addressed to the IEEE Editorial Department, 345 East 47 Street, New York, N. Y. 10017. Copyright © 1971 by The Institute of Electrical and Electronics Engineers, Inc. Printed in U.S.A. Second-class postage paid at New York, N. Y., and additional mailing offices.