



The Microwave Theory and Techniques Society is an organization, within the framework of the IEEE, of members with principal professional interests in the field of microwave theory and techniques. All members of the IEEE are eligible for membership in the Society and will receive the LETTERS upon payment of the annual Society membership fee of \$8.00, plus an annual subscription fee of \$8.00. Affiliate membership is available upon payment of the annual affiliate fee of \$35.00, plus an annual subscription fee of \$8.00. For information on joining, write to the IEEE at the address below. *Member copies of Transactions/Journals are for personal use only.*

ADMINISTRATIVE COMMITTEEC. M. JACKSON, *President*J. T. BARR IV, *Vice President*W. A. SHIROMA, *Secretary*J. S. KENNEY, *Treasurer*

J. T. BARR IV
M. P. DE LISIO
S. M. EL-GHAZALY
S. J. FIEDZIUSZKO

K. C. GUPTA
M. HARRIS
K. HONJO

C. M. JACKSON
J. S. KENNEY
R. B. MARKS

J. MODELSKI
J. M. POND
M. J. SCHINDLER

R. SORRENTINO
F. J. SULLIVAN
G. THOREN

R. J. TREW
K. VARIAN
S. WETENKAMP

Honorary Life Members

A. C. BECK
S. B. COHN
T. ITOH
A. A. OLINER
K. TOMIYASU
L. YOUNG
T. S. SAAD

Distinguished Lecturers

R. COMPTON
T. J. BRAZIL
H. J. DE LOS SANTOS
J. JENSEN
A. KATZ
T. LEE

Past Presidents

R. B. MARKS
W. MENZEL
R. WEIGEL
R. W. SUDBURY (2000)
E. A. REZEK (1999)
R. D. POLLARD (1998)

S-MTT Chapter Chairmen

Albuquerque: C. C. COURTNEY
Atlanta: J. LASKAR
Baltimore: J. MOELLERS, B. SEQUEIRA
Beijing: W. X. ZHANG, Y.-R. ZHONG
Benelux: B. NAUWELAERS
Buffalo: M. R. GILLETTE
Bulgaria: P. I. PHILIPOV
Central Iowa/Cedar Rapids: J. C. COZZIE, D. E. OLIVER
Central New England/Boston: J. L. HEATON, III
Central & South Italy: P. BERNARDI
Central Virginia: S. H. JONES
Chicago: H. VALENZUELA
Cleveland: M. TABIB-AZAR
College Station: R. NEVELS, C. NGUYEN
Columbus: R. LEE
Czechoslovakia: Z. SKVOR
Dallas: D. T. BRYANT
Dayton: K. NAISHADHAM
Denver-Boulder: R. G. GEYER
Egypt: I. A. SALEM
Finland: J. J. TUOVINEN
Florida West Coast: G. M. BONAGUIDE
Foothills: B. B. SZENDRENYI
France: H. BAUDRAND
Germany: W. S. MENZEL
Greece: N. K. UZUNOGLU
Hong Kong: E. PUN
Houston: J. T. WILLIAMS, R. D. NEVELS
Hungary: I. FRIGYES
Huntsville: H. L. BENNETT, C. PLANT
India: K. S. CHARI
Indonesia: D. SIRAT
Israel: A. MADJAR
Ithaca: R. C. COMPTON, N. KOLIAS

Kitchener-Waterloo: R. R. MANSOUR
Korea: S.-W. YUN
Lithuania: B. LEVITAS
Los Angeles: J. A. VERKADE
Milwaukee: J. RICHIE
Minsk Belarus: S. A. MALYSHEV
Mohawk Valley: E. P. RATAZZI
Montreal: G. L. YIP
Moscow: V. E. LYUBCHENKO
Nanjing: W. X. ZHANG
New Hampshire: T. L. PERAGINE
New Jersey Coast: T. P. HIGGINS
New South Wales: K. P. ESSELLE
New York/Long Island: M. HANCZOR
Nizhny Novgorod: Y. I. BELOV
North Italy: C. N. NALDI
North Jersey: C. GUPTA
Novosibirsk: B. KAPILEVICH
Orlando: T. IVANOV
Ottawa: D. H. REEKIE
Philadelphia: E. HOLZMAN
Phoenix: A. C. REYES
Poland: B. LEVITAS, S. A. MALYSHEV, E. SEDEK
Portland: V. K. TRIPATHI
Portugal: J. J. L. FREIRE
Princeton/Central Jersey: W. R. CURTICE
Rio de Janeiro/Brazil: J. R. BERGMANN
Russia: Y. I. BELOV, V. A. KALOSHIN, B. Y. KAPILEVICH, S. TRETYAKOV
San Diego: U. DHALIWAL
San Fernando Valley: J. WEILER, JR.
Santa Clara Valley/San Francisco: E. CAMARGO
Sao Paulo: A. O. M. ANDRADE, D. CONSONI
Saratov/Penza: M. V. DAVIDOVICH

Schenectady: R. J. GUTMANN
Seattle: W. CHARCZENKA, M. CHEN
Singapore: Y. T. SOON
South Africa: D. B. DAVIDSON
South Australia: H. J. HANSEN
South Brazil: A. O. M. ANDRADE
South Brevard Indian River: T. E. DURHAM, M. THURSBY
Southeastern Michigan: T. GROTHJOHN
Spain: L. DE-HARO
Springfield: J. B. MEAD
St. Louis: K. E. KRAUSE
St. Petersburg: S. TRETYAKOV
Sweden: J. JOHANSSON
Switzerland: R. VAHLDIECK
Syracuse: T. SARKAR
Taipei: M. H. CHEN
Taiwan: S. H. HSU, J. L. LIUANG
Tbilisi: D. KARKASHADZE
Thailand: N. YOOTHANOM
Tokyo: I. AWAI
Toronto: T. E. VAN DEVENTER
Tucson: VACANT
Turkey: A. ALTINTAS
Twin Cities: M. J. GAWRONSKI
Ukraine East: Y. S. SHIFRIN
Ukraine Kiev: Y. M. POPLAVKO
Ukraine West: N. N. VOITOVICH, R. S. ZARIDZE
United Kingdom/Ireland: N. WILLIAMS
Venezuela: A. N. BIANCHI
Victorian: R. B. WATERHOUSE
Virginia Mountain: VACANT
Washington DC/Northern Virginia: R. A. KAUL
Winnipeg: L. SHAFAI
Yugoslavia: B. S. JOCANOVIC

IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS**Editor-in-Chief**

S. M. EL-GHAZALY
Editorial Assistant
S. HENZ

Associate Editors

H. OGAWA (*Asia-Pacific Abstracts*)
Sub-Associate Editor
S.-J. XU

R. VALDIECK
A. SHARMA
S. KAWASAKI

H. C. BELL (*Patent Abstracts*)

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.**Officers**

JOEL B. SNYDER, *President*
RAYMOND D. FINDLAY, *President-Elect*
HUGO M. FERNANDEZ VERSTEGEN, *Secretary*
DALE M. CASTON, *Treasurer*
LYLE D. FEISEL, *Vice President, Educational Activities*

JAMES M. TIEN, *Vice President, Publications, Products, & Services*
MAURICE PAPO, *Vice President, Regional Activities*
MARCO W. MIGLIARO, *President, Standards Association*
LEWIS M. TERMAN, *Vice President, Technical Activities*
NED R. SAUTHOFF, *President, IEEE USA*

PETER W. STAECKER, *Director, Division IV—Electromagnetics and Radiation*

Executive Staff

DANIEL J. SENESE, *Executive Director*

DONALD CURTIS, *Human Resources*
ANTHONY DURNIAK, *Publications, Products & Services*
JUDITH GORMAN, *Standards Activities*
CECELIA JANKOWSKI, *Regional Activities*
PETER A LEWIS, *Educational Activities*

RICHARD D. SCHWARTZ, *Business Administration*
W. THOMAS SUTTLE, *Professional Activities*
MARY WARD-CALLAN, *Technical Activities*
JOHN WITSKEN, *Information Technology*

IEEE Periodicals**Transactions/Journals Department**

Staff Director: FRAN ZAPPULLA
Editorial Director: DAWN M. MELLEY
Production Director: ROBERT SMREK
Transactions Manager: GAIL S. FERENC
Managing Editor: MARTIN J. MORAHAHAN

IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS (ISSN 1531-1309) is published monthly by The Institute of Electrical and Electronics Engineers, Inc. Responsibility for the contents rests upon the authors and not upon the IEEE, the Society/Council, or its members. **IEEE Corporate Office:** 3 Park Avenue, 17th Floor, New York, NY 10016-5997. **IEEE Operations Center:** 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331. **NJ Telephone:** +1 732 981 0060. **Price/Publication Information:** Individual copies: IEEE Members \$10.00 (first copy only), nonmembers \$20.00 per copy. (Note: Add \$4.00 postage and handling charge to any order from \$1.00 to \$50.00, including prepaid orders.) Member and nonmember subscription prices available on request. Available in microfiche and microfilm. **Copyright and Reprint Permissions:** Abstracting is permitted with credit to the source. Libraries are permitted to photocopy for private use of patrons, provided the per-copy fee indicated in the code at the bottom of the first page is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923. For all other copying, reprint, or republication permission, write to Copyrights and Permissions Department, IEEE Publications Administration, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331. Copyright © 2001 by The Institute of Electrical and Electronics Engineers, Inc. All rights reserved. Periodicals Postage paid at New York, NY, and at additional mailing offices. **Postmaster:** Send address changes to IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS, IEEE, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331. GST Registration No. 125634188. Printed in U.S.A.