



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 \$10.00, plus an annual subscription fee of \$10.00. Affiliate membership is available upon payment of the annual affiliate fee of \$40.00, plus an annual subscription fee of \$10.00. For information on joining, write to the IEEE at the address below. *Member copies of Transactions/Journals are for personal use only.*

ADMINISTRATIVE COMMITTEE

C. M. JACKSON, <i>President</i>	J. T. BARR IV, <i>Vice President</i>	W. A. SHIROMA, <i>Secretary</i>	J. S. KENNEY, <i>Treasurer</i>
J. T. BARR IV	K. C. GUPTA	J. MODELSKI	R. J. TREW
M. P. DE LISIO	M. HARRIS	J. M. POND	K. VARIAN
S. M. EL-GHAZALY	K. HONJO	M. J. SCHINDLER	S. WETENKAMP
S. J. FIEDZIUSZKO			

Honorary Life Members

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

Distinguished Lecturers

F. ALI	H. J. DE LOS SANTOS	CH. SCHAFER
P. ASBECK	A. KATZ	A. SEEDS
R. COMPTON	TH. LEE	R. WEIGEL
	G. REBEIZ	

Past Presidents

R. W. SUDBURY (2000)
E. A. REZEK (1999)
R. D. POLLARD (1998)

S-MTT Chapter Chairmen

Albuquerque: C. C. COURTNEY	Kitchener-Waterloo: R. R. MANSOUR	Schenectady: R. J. GUTMANN
Atlanta: J. LASKAR	Korea: S.-W. YUN	Seattle: W. CHARCZENKA, M. CHEN
Baltimore: J. MOELLERS, B. SEQUEIRA	Lithuania: B. LEVITAS	Singapore: Y. T. SOON
Beijing: W. X. ZHANG, Y.-R. ZHONG	Los Angeles: J. A. VERKADE	South Africa: D. B. DAVIDSON
Benelux: B. NAUWELAERS	Milwaukee: J. RICHIE	South Australia: H. J. HANSEN
Buffalo: M. R. GILLETTE	Minsk Belarus: S. A. MALYSHEV	South Brazil: A. O. M. ANDRADE
Bulgaria: P. I. PHILIPPOV	Mohawk Valley: E. P. RATAZZI	South Brevard Indian River: T. E. DURHAM, M. THURSBY
Central Iowa/Cedar Rapids: J. C. COZZIE, D. E. OLIVER	Montreal: G. L. YIP	Southeastern Michigan: T. GROTHORN
Central New England/Boston: J. L. HEATON, III	Moscow: V. E. LYUBCHENKO	Spain: L. DE-HARO
Central & South Italy: P. BERNARDI	Nanjing: W. X. ZHANG	Springfield: J. B. MEAD
Central Virginia: S. H. JONES	New Hampshire: T. L. PERAGINE	St. Louis: K. E. KRAUSE
Chicago: H. VALENZUELA	New Jersey Coast: T. P. HIGGINS	St. Petersburg: S. TRETYAKOV
Cleveland: M. TABIB-AZAR	New South Wales: K. P. ESSELLE	Sweden: J. JOHANSSON
College Station: R. NEVELS, C. NGUYEN	New York/Long Island: M. HANCZOR	Switzerland: R. VAHLDECK
Columbus: R. LEE	Nizhny Novgorod: Y. I. BELOV	Syracuse: T. SARKAR
Czechoslovakia: Z. SKVOR	North Italy: C. N. NALDI	Taipei: M. H. CHEN
Dallas: D. T. BRYANT	North Jersey: C. GUPTA	Taiwan: S. H. HSU, J. L. LIUANG
Dayton: K. NAISHADHAM	Novosibirsk: B. KAPILEVICH	Tbilisi: D. KARKASHADZE
Denver-Boulder: R. G. GEYER	Orlando: T. IVANOV	Thailand: N. YOTHANOM
Egypt: I. A. SALEM	Ottawa: D. H. REEKIE	Tokyo: I. AWAI
Finland: J. J. TUOVINEN	Philadelphia: E. HOLZMAN	Toronto: T. E. VAN DEVENTER
Florida West Coast: G. M. BONAGUIDE	Phoenix: A. C. REYES	Tucson: VACANT
Foothills: B. B. SZENDRENYI	Poland: B. LEVITAS, S. A. MALYSHEV, E. SEDEK	Turkey: A. ALTINTAS
Fort Worth: G. C. MAY	Portland: V. K. TRIPATHI	Twin Cities: M. J. GAWRONSKI
France: H. BAUDRAND	Portugal: J. J. L. FREIRE	Ukraine East: Y. S. SHIFRIN
Germany: W. HEINRICH	Princeton/Central Jersey: W. R. CURTICE	Ukraine Kiev: Y. M. POPLAVKO
Greece: N. K. UZUNOGLU	Rio de Janeiro/Brazil: J. R. BERGMANN	Ukraine West: N. N. VOITOVICH, R. S. ZARIDZE
Hong Kong: E. PUN	Russia: Y. I. BELOV, V. A. KALOSHIN,	United Kingdom/Ireland: N. WILLIAMS
Houston: J. T. WILLIAMS, R. D. NEVELS	B. Y. KAPILEVICH, S. TRETYAKOV	Venezuela: A. N. BIANCHI
Hungary: I. FRIGYES	San Diego: U. DHALIWAL	Victorian: R. B. WATERHOUSE
Huntsville: H. L. BENNETT, C. PLANT	San Fernando Valley: J. WEILER, JR.	Virginia Mountain: VACANT
India: K. S. CHARI	Santa Clara Valley/San Francisco: E. CAMARGO	Washington DC/Northern Virginia: R. A. KAUL
Indonesia: D. SIRAT	Sao Paulo: A. O. M. ANDRADE, D. CONSONI	Winnipeg: L. SHAFAI
Israel: A. MADJAR	Saratov/Penza: M. V. DAVIDOVICH	Yugoslavia: B. S. JOCANOVIC
Ithaca: R. C. COMPTON, N. KOLIAS		

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**

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

JAMES M. TIEN, *Vice President, Publications, Products & Services*
 W. CLEON ANDERSON, *Vice President, Regional Activities*
 BEN C. JOHNSON, *President, Standards Association*
 MICHAEL R. LIGHTNER, *Vice President, Technical Activities*
 LEARL A. BRYANT, *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*
 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. MORAHAN

Assistant Editor: MEGAN R. VOREL

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 © 2002 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.