

IEEE JOURNAL OF SOLID-STATE CIRCUITS

The IEEE JOURNAL OF SOLID-STATE CIRCUITS is published by the IEEE Solid-State Circuits Society. For membership and subscription information and pricing, please visit www.ieee.org/membership-catalog.

SOLID-STATE CIRCUITS SOCIETY <http://sscs.org>

President
B. BOWHILL
Intel
Framingham MA

Vice President
D. FRIEDMAN
IBM
Yorktown Heights,
NY, USA

Secretary
B. FLOYD
North Carolina State University
USA

Treasurer
K. WILCOX
AMD
Boxborough, MA, USA

Past-President
J. LONG
University of Waterloo
Waterloo, ON, Canada

Executive Office
sscs@ieee.org
Executive Director:
A. GREENBERG
phone: 732 465-6459
a.greenberg@ieee.org

ADMINISTRATIVE COMMITTEE

Elected for 2023-2025 Term
A. KLINEFELTER
Nvidia

C. MANGELSDORF

M. TAKAMIYA
University of Tokyo

C. TOKUNAGA
Intel

Z. TOPRAK DENIZ
IBM

Elected for 2024-2026 Term
J.-H. CHOI
Samsung Electronics

N. COLLAERT
imec

P. HARPE
Eindhoven University of
Technology

T. PIESSENS
Icsense

R. YAZICIGIL
Boston University

Elected for 2025-2027 Term
P. H. HSIEH
Tsing Hua University

D. MANSTRETTA
Università di Pavia

K. OKADA
Institute of Science Tokyo

Z. LULEC
Analog Devices

M. ORTMANN
University of Ulm

STANDING COMMITTEE CHAIRS

Awards
K.K.O
Univ Texas at Dallas
TX, USA

Chapters
A. L. LOKE
Qualcomm
San Diego, CA, USA

Education
F. TAVERNIER
KU Leuven
Leuven, Belgium

Conferences
A. PIOVACCARI
Austin, TX, USA

Membership
M. IKEDA
the university of Tokyo
Tokyo, Japan

Nominations
J. LONG
University of Waterloo
Waterloo, ON, Canada

Publications
S. PAVAN
Indian Institute of
Technology, Madras
Chennai, India

Women in Circuits
Z. TOPRAK DENIZ
IBM
Yorktown Heights,
NY, USA

EDITOR

BORIS MURMANN
Dep. of Electr. & Comput. Eng.
University of Hawai'i at Mānoa
Honolulu, HI 96822
jssc.eic.murmann@gmail.com

Associate Editors

Y. CHAE
Yonsei University
Seoul, Korea
yhae@yonsei.ac.kr

J. CHOI
Dept. of Electrical and Computer
Engineering
Seoul National University
Korea
jaehyouk@snu.ac.kr

T. DINC
Texas Instruments
Dallas, TX USA
t-dinc@ti.com

Y. DONG
MediaTek Inc.
Woburn, MA 01801, USA
yunzhi.dong@ieee.org

DR. N. A. W. DUTTON
STMicroelectronics
Edinburgh, U.K.
neale.dutton@st.com

Q. FAN
Delft University of Technology
Delft, Zuid Holland, NL
q.fan@tudelft.nl

M. FUJISHIMA
Graduate Sch. of
Adv. Science & Eng.
Hiroshima University
Japan
fuji@hiroshima-u.ac.jp

V. GIANNINI
L&T Semiconductor Technologies
Austin, TX, USA
vito.giannini@ieee.org

J. GU
Northwestern University
Evanston, IL
USA
jgu@northwestern.edu

Q. J. GU
TSRB 447
Georgia Institute of Technology
85 5th St NW
Atlanta, GA 30332
jane.gu@gatech.edu

T. JANG
Institute of Integrated Systems
ETH Zurich
Switzerland
tkjang@ethz.ch

B. KELLER
NVIDIA Research
Santa Clara, CA
USA
benk@nvidia.com

C. KIM
Korea University
Seoul, Republic of Korea
ckim@korea.ac.kr

H. LEE
Department of Electrical and
Computer Engineering
University of Texas at Dallas
USA
hoilee@utdallas.edu

T. C. LEE
National Taiwan University
Taiwan
tlee@ntu.edu.tw

S. MATTHEW
Intel Corp. USA
sanu.k.matthew@intel.com

M. ORTMANN
University of Ulm
Ulm, Germany
maurits.ortmanns@uni-ulm.de

S. PALERMO
Texas A&M University
College Station, TX USA
spalermo@tamu.edu

P. RAINA
Stanford University
Stanford, CA USA
praina@stanford.edu

B. SADHU
IBM T. J. Watson Research Center
Yorktown Heights, NY 10598, USA
sadhu@us.ibm.com

V. SATHE
Georgia Institute of Technology
Atlanta, GA USA
sathe@gatech.edu

F. SEBASTIANO
Delft University of Technology
The Netherlands
f.sebastiano@tudelft.nl

J. T. STAUTH
Thayer School of Engineering at Dartmouth
Hanover, NH
USA
jason.t.stauth@dartmouth.edu

K. TAKEUCHI
The University of Tokyo
Tokyo, Japan
takeuchi@co-design.t.u-tokyo.ac.jp

W. WU
Samsung Semiconductor, Inc.
San Jose, CA USA
jssc.wanghuawu@gmail.com

H. XU
Fudan University
Shanghai, China
hongtao@fudan.edu.cn

C. H. YANG
National Taiwan University
Taipei, Taiwan
chyee@ntu.edu.tw

IEEE Officers

MARY ELLEN RANDALL, *IEEE President and CEO*
JILL I. GOSTIN, *IEEE President-Elect*
JENIFER P. CASTILLO RODRIGUEZ, *Director & Secretary*
GERARDO BARBOSA, *Director & Treasurer*
KATHLEEN A. KRAMER, *IEEE Past President*

TIMOTHY P. KURZWEG, *Director & Vice President, Educational Activities*
ANDREW D. LOWERY, *Director & Vice President, Member & Geographic Activities*
W. CLEM KARL, *Director & Vice President, Publication Services and Products*
DOROTHY V. STANLEY, *Director & President, Standards Association*
F D TAN, *Director & Vice President, Technical Activities*
BARRY C. TILTON, *Director & President, IEEE-USA*

FERNANDO J. GUARIN, *Director & Delegate, Division I*

IEEE Executive Staff

SOPHIA A. MUIRHEAD, *Executive Director and Chief Operating Officer*

KELLY ARMSTRONG, *Chief Financial Officer*
MOJDEH BAHAR, *Managing Director, Technical Activities*
AHSAKI E. BENION, *General Counsel and Chief Compliance Officer*
RUSSELL HARRISON, *Managing Director, IEEE-USA*
STEVEN HEFFNER, *Chief Publication Officer and Managing Director*
DONNA HOURICAN, *Chief Governance Officer*
MARIE HUNTER, *Managing Director, Conferences, Events and Experiences*

CECELIA JANKOWSKI, *Managing Director, Member and Geographic Activities*
JAMIE MOESCH, *Managing Director, Educational Activities*
JAYNE O'BRIEN, *Chief Marketing Officer*
ALPESH SHAH, *Managing Director, IEEE Standards*
JEFF STROHSCHN, *Chief Information and Digital Officer*
ALLISON TAYLOR, *Chief of Staff*
CHERI N. WIDEMAN, *Chief Human Resources Officer*

IEEE Publishing Operations

Senior Director, Publishing Operations: DAWN MELLEY
Director, Editorial Services: KEVIN LISANKIE Director, Production Services: PETER M. TUOHY
Associate Director, Digital Assets & Editorial Support: NEELAM KHINVASARA
Senior Manager, Journals Production: PATRICK KEMPF Journals Production Manager: SARA T. SCUDDER

IEEE JOURNAL OF SOLID-STATE CIRCUITS (ISSN 0018-9200) 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. **IEEE Operations Center:** 445 Hoes Lane Piscataway, NJ 08854. **NJ Telephone:** +1 732 981 0060. **Price/Publication Information:** To order individual copies for members and nonmembers, please email the IEEE Contact Center at contactcenter@ieee.org. Member and nonmember subscription prices available on request. Available on CD-ROM and DVD (see <http://www.sscs.org/jssc/>). **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 of \$31.00 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, Piscataway, NJ 08854. Copyright © 2026 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 JOURNAL OF SOLID-STATE CIRCUITS, IEEE, 445 Hoes Lane, Piscataway, NJ 08854. GST Registration No. 125634188. CPC Sales Agreement #40013087. Return undeliverable Canada addresses to: Pitney Bowes IMEX, P.O. Box 4332, Stanton Rd., Toronto, ON M5W 3J4, Canada. IEEE prohibits discrimination, harassment and bullying. For more information visit <http://www.ieee.org/nondiscrimination>. Printed in U.S.A.