Editorial

THE RF power amplifier has emerged as one of the most important components of both portable and infrastructure wireless equipment. This significance is due to its importance in establishing the performance characteristics of the communications link, its relatively large impact on equipment costs, and its impact on reliability. This significant role is expected to continue with development of third–generation (3G) and fourth–generation (4G) wireless systems, which have adopted modulation formats with significant amplitude modulation in order to increase channel capacity. In fact, several wireless equipment developers have recently announced delays in 3G deployment due specifically to thermal limitations in portable terminals.

Over the last five years, a tremendous amount of novel research and patent activity has taken place in RF power amplification, including areas such as semiconductor technology, novel circuit architecture development, and the integration of signal-processing functions. This TRANSACTIONS' Special Issue addresses many of these recent advances.

The guest editors of this Special Issue have chosen a variety of papers to illustrate not only what has been achieved recently, but also to illustrate possible trends in the evolution of RF power amplification. Several of the papers are based on amplifiers using CMOS technology, or are capable of being used with CMOS technology. For reasons of cost and integration, this trend is expected to continue, particularly for applications requiring relatively low average power or applications where narrow-band linearization techniques can be used, such as envelope elimination and restoration (EER).

Other papers were chosen to illustrate that classical methods, combined with modern semiconductors and signal-processing techniques, still play an important role in achieving linearity and efficiency improvement. Modern implementation of classical techniques such as class E, EER, and predistortion have all shown significant improvements due to advances in semiconductor and signal-processing techniques.

Although virtually all handset power amplifiers are currently based on classical multistage single-ended architectures and virtually all infrastructure power amplifiers are based on feed forward, what this Special Issue's papers demonstrate is that techniques currently exist for addressing the problems leading to delays in deployment of 3G wireless systems. Next-generation handsets, capable of communicating at rates in excess of 1 Mb/s will no doubt adopt some of the technology described in this Special Issue.

The guest editors would like to thank all the authors for their hard work in preparing this Special Issue. In addition, the guest editors would also like to thank all of the reviewers for their effort in selecting these papers. Finally, thanks go to this TRANSACTIONS' Editor-in-Chief David Rutledge, Robert York, and Carol Sosnowski for their guidance and assistance.

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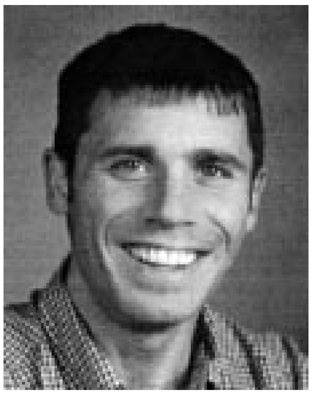
He is currently Professor of Electrical and Computer Engineering at North Carolina State University, Raleigh. In 1999 and 2000, he was a Professor in the School of Electronic and Electrical Engineering, The University of Leeds, where he held the Chair in Microwave and Millimeter-wave Electronics. He was also the Director of the Institute of Microwaves and Photonics, The University of Leeds. Until 1996, he was the founding Librarian of the IBIS (I/O Buffer Information Specification) Consortium, which provides a forum for developing behavioral models. He has organized many workshops and taught many short courses on signal integrity, wireless, and RF design. He has authored or co-authored over 200 refereed papers and book chapters on topics related to RF and microwave design methodology. He co-authored *Foundations of Interconnect and Microstrip Design* (New York: Wiley, 2000). His current research projects include global modeling integrating the electromagnetic, circuit, thermal, and mechanical analyses of large electronic systems, the integrated modeling and design of RF transmitter systems by optimizing coding, modulation format, RF circuitry, filters, amplifiers, and antennas to achieve significantly longer battery life and new communication protocols, and the modeling and fundamental understanding of high-power millimeter-wave, and terahertz spatially distributed systems. His specific work is also directed at RF and microwave design, linearization of efficient power amplifiers, spatial power-combining systems, design of millimeter-wave and terahertz frequency communication and imaging systems, and high-efficiency low-cost RF technologies for wireless applications.

Prof. Steer is active in the IEEE Microwave Theory and Techniques Society (IEEE MTT-S). In 1997, he was secretary of the IEEE MTT-S and was an elected member of the Administrative Committee for the 1998–2000 term. He was a 1987 Presidential Young Investigator. In 1994 and 1996, he was the recipient of the Bronze Medallion presented by the Army Research Office for "Outstanding Scientific Accomplishment."



John Sevic (S'87–M'90) received the B.S.E.E. degree (with honors) from the Michigan Technological University, Houghton, in 1989, and the M.S.E.E. degree from the Illinois Institute of Technology, Chicago, in 1992, both with an emphasis in microwave engineering.

In 1989, he joined Motorola, where he was engaged in the design and development of RF power amplifiers for cellular infrastructure and portable applications. He possesses extensive experience in the design of high-efficiency and high-linearity RF power amplifiers using standard methods and more advanced methods, such as feed-forward, Doherty, and adaptive gate-switching with Si bipolar junction transistor (BJT) and LDMOS and GaAs MESFET, pseudomorphic high electron-mobility transistor (pHEMT), and heterojunction bipolar transistor (HBT) technologies. While with Motorola, he pioneered early developments of simulating and characterizing nonlinearity using adjacent channel power ratio (ACPR), particularly for ANSI-136 and RCR-27b. He developed the first load–pull system capable of characterizing ACPR for ANSI-136, RCR-27b, and IS-95, and was also heavily involved in validating Agilent's Circuit Envelope simulation engine, providing the first ANSI-136 and IS-95 ACPR validation results and ACPR calculation templates. Also while with Motorola, he developed Volterra MESFET models, which led to a first understanding of the sources of ACPR and intermodulation (IM) asymmetry and novel techniques for asymmetry characterization and mitigation. In 1996, he joined Qualcomm, where he managed their early development of CDMA-cellular and CDMA-PCS portable power amplifiers. His group published the first paper illustrating the influence of long-term power statistics on average efficiency. This concept was validated by developing an LDMOS integrated radio-frequency integrated-circuit (RFIC) module, and led to a patented method of improving back-off efficiency of CDMA RF power amplifiers. In 1997, he joined Spectrian, where he was Director of the RF Design Group within the LDMOS Fabrication Facility. He and his group developed an Si RFIC library where inductor Q's of over ten were achieved at 2 GHz using a dual-layer gold process. Work in this area also led to development of novel current mirror circuits for HCI tracking and development of an LDMOS die with a record high power density at 2 GHz and 26 V. His group also developed Doherty RF power amplifiers for multicarrier applications and a thick-film alumina module design kit based on the Agilent ADS design environment. He also conducted advanced modeling and characterization techniques, including development of a quarter-wave prematching network for load–pull, which achieved a 400 : 1 mismatch with respect to 50 Ω at 2 GHz. In 2001, he joined Tropian, Cupertino, CA, a startup company pioneering polar modulation techniques applied to high-efficiency linear RF power amplifiers. At Tropian, he is responsible for multicarrier power-amplifier development using polar modulation techniques in conjunction with switch-mode RF power amplifiers. He has authored or co-authored over 20 refereed publications and invited talks and three book chapters. He holds seven patents, with several pending.

Mr. Sevic is a registered Professional Engineer in the state of Illinois. He serves on the Editorial Review Board for the IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES and the IEEE Microwave Theory and Techniques Society (IEEE MTT-S) International Microwave Symposium. He was the recipient of the 1998 Best Paper Award presented at the Fall Automatic RF Techniques Group Conference.

Bernard D. Geller (S'67–M'67–SM'78) received the B.E.S. degree in electrical engineering from the Johns Hopkins University, Baltimore, MD, in 1967, and the M.S.E.E. degree from the University of Maryland at College Park, in 1974.

In 1967, he joined the Westinghouse Electric Corporation. In 1969, he joined the Westinghouse Advanced Technology Laboratories, Baltimore, MD, where he contributed to the development of a wide range of microwave components and circuits for radar systems, including various signal-control components, IMPATT oscillators and amplifiers, and FET amplifiers and power combiners. In 1979, he joined COMSAT Laboratories and, in 1983, he became Manager of the Microwave Circuits Department. While with COMSAT, he developed high-efficiency and high-linearity FET power amplifiers for satellite communications, monolithic-microwave integrated-circuit (MMIC) components for both satellite and very small aperture terminal (VSAT) applications, and RF subsystem integration techniques. In 1994, he joined the Sarnoff Corporation (formerly the David Sarnoff Research Center), where he led the development of MMICs for wireless applications and advanced RF and mixed-signal packaging techniques using low-temperature co-fired ceramics (LTCCs). In November of 2000, he joined the Design Engineering Center, Mitsubishi Electric and Electronics, Durham, NC, where he currently manages the High Frequency RF Design Section and is engaged in the development of MMIC components for communications applications. He holds 13 U.S. patents, all in the RF and microwave circuit area.

Mr. Geller is co-chair of the IEEE Microwave Theory and Techniques Society (IEEE MTT-S) MTT-20 (Wireless Communications). He has been an active member of the Technical Program Committee of the IEEE MTT-S International Microwave Symposium (IMS). He has helped organize workshops and special sessions at the IEEE MTT-S IMS, as well as at the European Microwave Conference, and has served on the Technical Program Committee (TPC) of the Radio and Wireless Conference (RAWCON) for the last several years. He chaired the TPC of the 1999 IEEE MTT-S Topical Symposium on Technologies for Wireless Applications, Vancouver, BC. In 2000, he was chairman of the Sarnoff Symposium on Advances in Wired and Wireless Communications. He was the recipient of an Achievement Award for his work in the LTCC area.