Energy-Efficient Microwave Components For Mobile Communication



Yuanan Liu **Quanyuan Feng** **Fadhel M. Ghannouchi**

In the coexisted world of 3G, 4G, 5G and many other specialized wireless communication systems, billions of connections could be existing for various information transmission types. Unluckily, data show that the increase of network capacity is heavily more than the increase of the network energy efficiency in recent years, which could lead to more energy consumption per transmitted bit in the future network. As basic units in mobile communication systems, microwave/RF components and modules play key roles in energy-efficiency of the wideband/broadband wireless communication systems due to the high peak-to-average power ratio (PAPR) in the modulated signals. This leads to high frequency-spectrum efficiency but low energy-efficiency. With further increasing both PAPR and bandwidth in 4G and 5G systems, the challenge of energy-efficiency originating from microwave components will dramatically increase. That is why the guest editors organized this Special Topic Issue.

For energy-efficient microwave components, this Special Topic Issue focuses on raising DC-to-RF conversion efficiency ranging from theoretical models to their practical realizations. Based on the submissions and careful peer review, four papers referring to circuit topologies and linearity improvement system are finally accepted by the guest editors. It is regretted that we were not able to accept more excellent papers within this Special Issue due to the limited space.

The first paper, "A 600W Broadband Doherty Power Amplifier with Improved Linearity for Wireless Communication System" proposes a three-way topology to reduce the complexity in matching networks brought by the low optimal impedance of high power transistors. The bias networks of this proposed three-way Doherty architecture are carefully considered to improve the linearity. The proposed high power three-way Doherty power amplifier (3W-DPA) is designed and fabricated. The measured concurrent two-tone results suggest that the linearity of DPA is improved by at least 5dB.

The second paper, "Non-Overlapping Conditions to Enable Multi-Dimensional Behavioral Models/DPDs for Multi-Band or Non-Continuous Carrier Aggregation Systems" derives the non-overlapping conditions for dual-band and tri-band signals and denotes in the form of closed-form expression. It can be valued to verify whether a given dual-band/multi-band signals can be linearized properly by the multi-dimensional behavioral models, which does not take the harmonic and intermodulation products of carriers' into account. Several dual-band and tri-band scenarios with different frequency spacing and maximum bandwidth were tested to verify the proposed non-overlapping condition.

The third paper,"Planar Compact Dual-Band Coupled-Line Balun with High Isolation" proposes a compact planar balun with high isolation and dual-band operations at 0.9/1.8GHz based on a circuit structure composing of three pairs of coupled lines. The circuit is analyzed by the even-(odd-) mode method as a symmetrical four-port circuit with one open port and is optimized by detailed simulations. The measured data show good agreement with the simulated results, and validate the circuit structure and the design analysis. This work is a useful attempt for dual-band balun towards the applications in multiband and multimode wireless communication.

The final paper, "Compact Coplanar Epsilon-Negative Antenna with Ultra-Wide Band Character" proposes a new wide band antenna with small size. The proposed antenna is fed by a coplanar-waveguide (CPW), and thus the via-free structure is employed to realize the ENG unit cell, which is convenient to tune the frequency of zero-order resonance

(ZOR) and extends the ZOR bandwidth. The measured results show that the proposed antenna covers the upper operation band of UWB communication protocol.

The guest editors deeply appreciate the authors for their contributions and sincerely thank the reviewers for their professional comments and patient work. Their professional opinions are the key to ensuring this Special Topic Issue in high quality.

Biographies

Yuanan Liu, received the B.E., M.Eng., and Ph.D. degrees in electrical engineering from University of Electronic Science and Technology of China, Chengdu, China, in 1984, 1989 and 1992, respectively. In 1984, he joined the 26th institute of Electronic Ministry of China to develop the inertia navigating system. In 1992, he began his first post-doctor position in EMC lab of Beijing University of Posts and Telecommunications (BUPT), Beijing, China. In 1995, he started his second post-doctor in broadband mobile lab of Department of System and Computer Engineering, Carleton University, Ottawa, Canada. From July, 1997, as professor, he is with wireless communication center of College of Telecommunication Engineering, BUPT, Beijing, China, where he is involved in the development of next-generation cellular system, wireless LAN, Bluetooth application for data transmission, EMC design strategies for high speed digital system, and Electromagnetic interference (EMI) and Electromagnetic Susceptibility (EMS) measuring sites with low cost and high performance. He is interested in smart antennas for high-capacity mobile signal processing techniques in fading environments, EMC for high-speed digital system, ISI suppression, orthogonal frequency division multiplexing (OFDM), and multicarrier system design. Dr. Liu is a Senior Member of the Electronic Institute of China.

Quanyuan Feng, Ph.D., IEEE senior member, professor of the School of Information Science and Technology in Southwest Jiaotong University (SWJTU), Chengdu, China. Director of the institute of microelectronics of SWJTU. His research interests include RF and microwave devices, integrated circuits design, RFID technology, wireless communications, antennas and propagation, microwave and millimeter wave technology, etc. Prof. Feng has published over 300 academic papers with SCI and EI index, and is reviewer for more than twenty journals and TCP member for several international conferences.

Fadhel M. Ghannouchi (S'84–M'88–SM'93–F'07), is currently an iCORE Professor and Senior Canada Research Chair with the Electrical and Computer Engineering Department, Schulich School of Engineering, University of Calgary, Calgary, AB, Canada, and Director of the Intelligent RF Radio Laboratory (iRadio Lab), University of Calgary. He has held several invited positions at several academic and research institutions in Europe, North America, and Japan. He has provided consulting services to a number of microwave and wireless communications companies. He has authored or coauthored over 450 publications. He holds 12 patents (with five pending). His research interests are in the areas of microwave instrumentation and measurements, nonlinear modeling of microwave devices and communications systems, design of power- and spectrum-efficient microwave amplification systems, and design of intelligent RF transceivers for wireless and satellite communications. Prof. Ghannouchi is a Fellow of Royal Society of Canada, a Fellow of the Canadian Academy of Engineering - Canadian Academy of Engineering, and a Fellow of the Engineering Institute of Canada - Engineering Institute of Canada. He is also a Fellow of IEEE and IET. He is a Distinguish Microwave Lecturer for the IEEE Microwave Theory and Techniques Society (IEEE MTT-S).