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03 November 2026

This Special Issue of IEEE Transactions on Microwave Theory and Techniques presents a collection of papers devoted to recent advances in power amplifiers (PAs) for communications and satellite applications. PAs remain key components in RF, microwave, millimeter-wave, and sub-terahertz transmitters, and designers are increasingly asked to optimize simultaneously several figures of merit, such as efficiency, output power, linearity, bandwidth, size and robustness.

The contributions included in this Special Issue cover a broad range of topics, from load-modulated architectures and broadband/multiband design to behavioral modeling, digital predistortion, flexible-spectrum operation, and satellite transmitter linearization. Taken together, they reflect the evolution of PA research toward a more integrated approach to transmitter design, in which circuit-level performance and system-level requirements are tightly connected.

A first group of papers addresses load modulation and back-off efficiency enhancement techniques. These topics remain central in modern transmitters, where high peak-to-average power ratio signals require efficient operation well below saturation. The Special Issue includes contributions on multiband outphasing power amplifiers, detailed study of loss mechanisms in load-modulated architectures, and advanced Doherty solutions. In particular, the issue presents a three-way Doherty PA with a diode-based self-adaptive bias network for extended output back-off operation, as well as a broadband Doherty design methodology based on an extended two-port S-parameter solution set and irregular matching networks. These works highlight the persistent relevance of Doherty and outphasing architectures, while also showing the need for more flexible synthesis and biasing techniques.

Load-modulated balanced amplifiers are also represented by a 62.5–72.5 GHz asymmetrical load-modulated balanced amplifier in 100-nm GaAs technology. This paper brings load-modulation concepts into the V-band domain, where passive losses, device constraints, and matching-network limitations of integrated solutions make efficiency enhancement particularly challenging.

Broadband, multiband, and concurrent operation form another important theme. One paper extends continuous Class-F theory to concurrent dual-band operation, emphasizing the role of intermodulation and baseband impedances in waveform engineering. Other contributions address a Ku- and K/Ka-band concurrent dual-band GaN MMIC PA for satellite and broadband applications, and a broadband power-reconfigurable nonuniform distributed amplifier using a gate-short method. These papers show how PA architectures are evolving to support multiple bands, wide bandwidths, and variable output power levels.

The Special Issue also includes work on design methodologies and algorithm-assisted synthesis. In addition to the irregular matching networks used for broadband Doherty design, one contribution proposes contour-superposed transmission-line structures with algorithm assistance for

broadband and dual-band PA design. These papers illustrate the growing role of optimization and layout-level degrees of freedom in managing increasingly complex impedance requirements.

Several papers focus and include important contributions in modeling, linearization, and system-level transmitter operation. A fading-memory pruning strategy is proposed to reduce the complexity of polynomial models for broadband PA digital predistortion. Digital predistortion architectures are also investigated for beamforming low-Earth-orbit satellite links, where large arrays and multiuser operation introduce new trade-offs between linearization performance and implementation complexity. In addition, empirical nonlinear behavioral modeling is explored for terahertz amplifiers using calibrated wideband measurements of D- and H-band devices.

Finally, the Special Issue includes a contribution on dynamic out-of-band distortion suppression with simultaneous efficiency enhancement for flexible-spectrum 6G applications. By using an injected control signal to manipulate the PA output impedance, this work addresses spectral containment and efficiency enhancement within the same transmitter framework.

Overall, the papers collected in this Special Issue show the vitality of current research on power amplifiers for communication and satellite systems. Classical PA design targets such as output power and drain efficiency remain essential, but they are now increasingly coupled with back-off operation, bandwidth, multiband capability, load modulation, linearization, beamforming, flexible spectrum use, and high-frequency integration. We hope that this Special Issue will provide a useful reference for researchers and engineers working on the next-generation RF, microwave, millimeter-wave, and sub-terahertz transmitters.

The Guest Editors would like to thank all the authors for their excellent contributions. We are also grateful to the reviewers for their careful and timely evaluations, which were essential to maintaining the technical quality of the Special Issue. Finally, we sincerely thank the Editor-in-Chief, the Associate Editors, the TMTT editorial office, and the IEEE Publications staff for their support throughout the preparation of this Special Issue.

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