

Duration: 09:00 – 18:20

Room: N117

WS-12

Wideband Supply Modulated RF Power Amplifiers for Energy Efficient Wireless Communication Infrastructure

Organisers:

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Abstract

The large instantaneous modulation bandwidth and high peak-to-average power ratio of signals used in future wireless communication systems is a challenge for the established power amplifier (PA) topologies targeting high back-off efficiency like Doherty PAs. Meanwhile, recent work on supply modulated systems, where the supply voltage of the PA is dynamically modified according to the envelope of the signal, have shown an impressive bandwidth improvement and competitive efficiency results. This is much attributed to the use of GaN technology for the fast switches in the supply modulators. Such systems allow, depending on the signal dynamics and frequency of operation, efficiency enhancement in the range of 10-20 %-points. Novel topology supply modulators and/or discrete level systems have shown the potential to be used in very large bandwidth, including integrated systems up to Ka-band for future cellular infrastructure (5G) and for space applications. The applications and possible suggested architectures for such systems will be presented in this workshop with their respective pros and cons.

A challenge in the design of such systems is the characterization and modelling for digital pre-distortion (DPD), since most systems feature a low-frequency (LF) supply modulator input in addition to the RF input. Multi-port vectorial data for such dual-input, single-output (DISO) system with one LF non-50 Ω port is required for the dynamic characterization necessary for extracting the appropriate shaping function. Some measurement solutions based on alternative hardware for the vectorial receiver and the LF path will be presented in this workshop, as well as novel DPD models optimized for linearization of DISO systems.

A special challenge in modelling poses discrete level supply modulated systems (class-G) with large discontinuous non-linearities, as well as supply modulated systems with digital supply modulators (class-S) where the dynamic supply signal is coded in a pulse-pattern.

Finally, with the novel communication systems operating at much higher frequencies, the technology is directed to smaller integrated transceiver cells, fabricated in short gate length GaN technology. The supply modulator operates in the baseband and is less affected by the RF operational frequency, but in general, the maximum supply voltage of the RF PA drops for short gate length technology, which lowers the expected performance improvement using supply modulation since the possible voltage swing is reduced. Furthermore, short channel GaN technology is more immature and shows larger trapping effects. In supply modulated systems, the drain lag can have a severe effect depending on the modulation BW and on the

type of supply modulation (discrete or continuous modulation). This is also discussed in the workshop.

Programme

Introduction

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Roadmap to Envelope Tracking in L-Band for Space Applications

Natanael Ayllon¹

¹European Space Agency

Efficient Supply-modulated GaN PAs for Wide RF and Instantaneous Bandwidths

Zoya Popovic¹

¹University of Colorado

Modular RF and Baseband Measurement Architectures Enabling Calibrated Multi-port Supply-modulated PAs

Marc Vanden Bossche¹

¹National Instruments

Digital Class-S Supply Modulators for Envelope Tracking

Andreas Wentzel¹

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Three-Port Characterization of Nonlinear Power Amplifiers using a PNA-X Microwave Network Analyzer

Francesco Tafuri¹

¹Keysight Technologies

Long-Term Memory Effects in GaN Devices: From Modeling to Compensation

Luís C. Nunes¹, Filipe Barradas¹, Cristiano Gonçalves¹, João Lucas¹, Pedro Tomé¹, Telmo R. Cunha¹, Pedro M. Cabral¹, José C. Pedro¹

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Wideband GaN-based Discrete Level Supply Modulated Power Amplifier Systems

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Conclusions and Discussion

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