Supply Modulation of Load-Modulated Power Amplifiers

Dan Fishler, Tommaso Cappello, Zoya Popović, and Taylor W. Barton
University of Colorado Boulder, USA

As peak to average power ratios (PAPRs) in commercial cellular systems trend higher, efficient power amplification increasingly requires a combination of multiple efficiency enhancement techniques in order to increase power amplifier (PA) efficiency at deep back-off. In particular, by adding supply modulation to existing architectures the range of efficient operation may be extended. The Load Modulated-PA (LM-PA) is a suitable candidate architecture to be combined with supply modulation because its multiple bias and supply voltages lead to many possible combinations of "control knob" settings.

In this work, two LM-PAs are designed, fabricated, and measured at 3.5 GHz using two identical 6W GaN devices with the goal of simultaneous efficiency and linearity for high-PAPR signals. The first PA under test is a Doherty PA (DPA) designed for a linear response using the method described in W. Hallberg, *et al.*, "A Doherty power amplifier design method for improved efficiency and linearity," MTT 2016. The second PA under test is a DPA designed using the "traditional" method for an improved efficiency back-off curve as described in W. H. Doherty, "A new high efficiency power amplifier for modulated maves," Proceedings of the Institute of Radio Engineers, 1936. The performance of these two DPAs is characterized under nominal bias and supply voltages. Efficiency is then further enhanced using supply modulation as shown in block diagram form of figure 1. We show that simultaneously modulating the main and auxiliary supplies leads to significant efficiency improvement, while linearity is maintained through digital pre-distortion (DPD). The results are compared and the trade-offs between the two architectures are discussed.

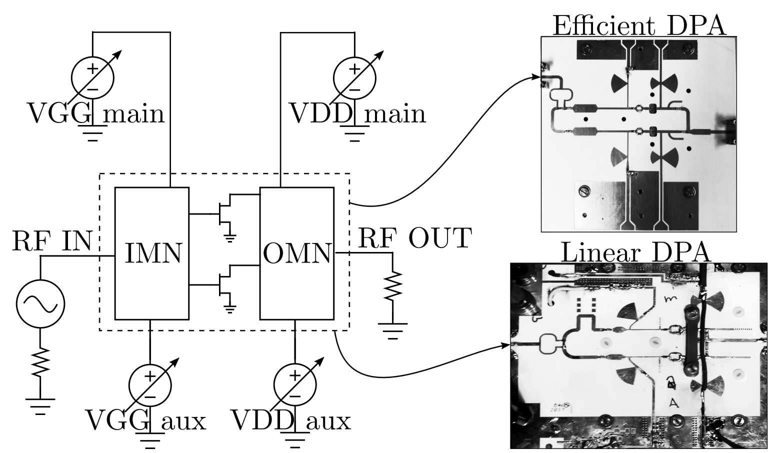

Figure 1. Experimental setup used in this work demonstrating the concept of "control knobs" to enhance efficiency at output power back-off. Photographs of the two DPAs characterized in this work are shown at right.