A Reconfigurable Broadband CMOS Power Amplifier for Long-Range WLAN Applications

Jaeyong Ko°, Bongkyun Seo and Sangwook Nam

School of Electrical and Computer Engineering, and INMC, Seoul National University

°sciencedo@ael.snu.ac.kr

I. Introduction

Despite the rapid developments of IEEE 802.11 devices in the 2.4 GHz frequency band and IEEE 802.15.4-based sensor devices in the ultrahigh frequency, a spectrum below 1 GHz has also kindled new attraction in both research and standardization due to its superiority in license exempt, lower obstruction loss, longer communication distance and ubiquitous access. The IEEE 802.11ah/af standards offer a WiFi-like experience with reasonable data rates up to and beyond a kilometer [1], [2]. Since the operation frequencies of 802.11ah/af are too broad for a single integrated PA to cover, a reconfigurable operation in the PA is required. In this work, a switchable balun/TF is employed as an in/output matching network of the PA, offering two modes of operation (LFM: 0.4-0.6 GHz, HFM: 0.6-1.1 GHz).

II. Design and Measurement Results

A reconfigurable broadband linear PA for long-range WLAN applications is presented, which is fabricated in a 180 nm RF CMOS process. With center frequencies of 0.5 GHz and 0.85 GHz, the reconfigurable operation at a proposed in/output matching network provides the PA with broadband behavior. The output matching network is realized by a switchable transformer which shows maximum peak passive efficiencies of 65.03% and 73.45% at 0.45 and 0.725 GHz, respectively. With continuous wave sources, an 1-dB bandwidth according to a saturated output power is 0.4-1.2 GHz, presenting an output power with a PAE of above 25.62 dBm with 19.65%, respectively. In addition to an adaptive power cell configuration at the common gate transistor, the measured PA under LTE 16-QAM 20 MHz (40 MHz) signals shows an average output power with a PAE of more than 20.22 (20.15) dBm with 7.42 (7.35)%, below an $ACLR_{E-UTRA}$ of -30 dBc, within the 1-dB bandwidth.

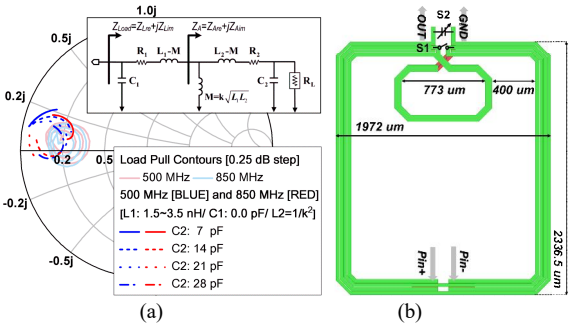

Fig. 1. (a) Normalized Z_{Load} with variations of L_1, L_2 and C_2 at 0.5 GHz and 0.85 GHz. (b) Physical layout of the designed OMN.

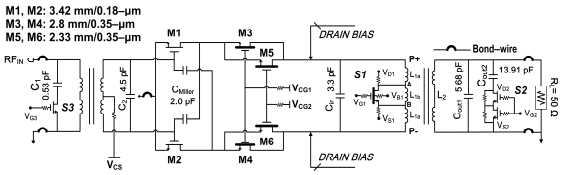

Fig. 2. Overall schematic of the proposed PA.

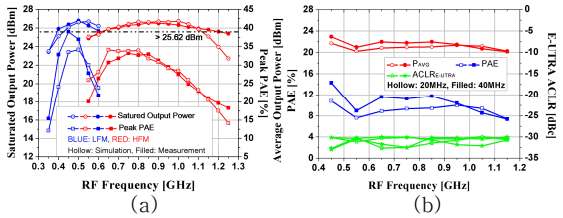

Fig. 3. (a) Simulated/measured P_{SAT} and peak PAE versus RF frequencies. (b) Measured LTE 16-QAM 20- and 40-MHz performance from 0.45 to 1.15 GHz.

Acknowledgement

This work was supported by the Brain Korea 21 Plus Project in 2018.

References

[1] W. Sun, M. Choi, and S. Choi, "IEEE 802.11ah: A long range 802.11 WLAN at sub 1 GHz," Journal of ICT Standardization, vol. 1, pp. 83–108, Apr. 2013.

[2] S. Aust, "IEEE 802.11ah: Advantages in standards and further challenges for sub 1 GHz Wi–Fi," Communications (ICC) IEEE, pp. 6885–6889, Jun. 2012.