# An Integrated Transformer with Reconfigurable S/X-Band Operation in a Single CMOS Power Amplifier

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## I. Introduction

In radar systems, the appropriate frequency band differs according to the environment. Therefore, it is desired to develop design approaches for dual band radar system which can use appropriate frequency band in different situations. However, most of the updated dual band power amplifiers (PAs) are not large enough for the frequency difference between two bands and they are designed with external matching networks [1]. This paper suggests the fully integrated dual-band CMOS power amplifier with a reconfigurable transformer.

## II. Design and Simulation Results

This paper applies a switched transformer for a dual-band matching network, using the 0.18-$\mu$m RF CMOS process. By using the designed transformer, as illustrated in Fig. 1, the load impedances can be located at the output power contours based on load-pull simulations at each band. The primary winding has an inner turn inductor to increase the inductance for the lower-band output matching, and a switch is connected in parallel to the inner turn inductor. To realize the tunable capacitor at secondary winding, a two-stacked transistor is used to have the power handling capability. In Fig. 2, differential cascode amplifiers are applied at driver and main stages, and resonance circuits for the X-band operation are used to minimize the load asymmetry due to generating an eddy-current loop at the inner turn winding.

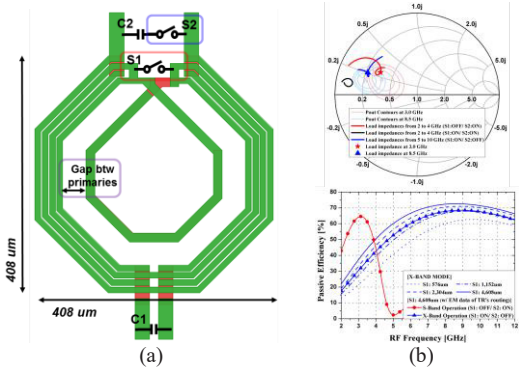


Fig. 1. (a) Physical layout of the designed transformer. (b) Normalized load impedances(upper) and passive efficiency(lower) with respect to the switches' operation.

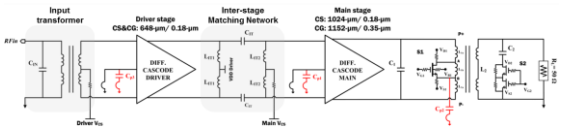


Fig. 2. Overall schematic of the two-stage reconfigurable dual-band CMOS PA.

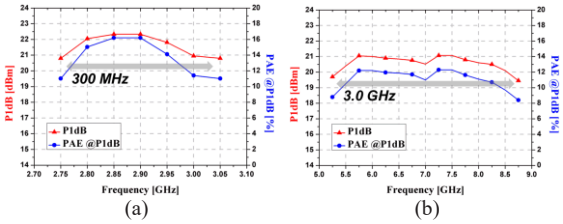


Fig. 3. Simulated P1dB and PAE versus frequency: (a) S-Band/ (b) X-Band.

As illustrated in Fig. 3, the proposed PA has a simulated P1dB of 21.0 dBm for both 2.9 GHz and 8.0 GHz using a 3.6-V supply. Since the PA shows the dual-band characteristic with the compatible performance at X-Band [2], this design approach can be useful for dual-band radar applications.

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## References

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[2] B.-H. Ku, S.-H. Baek, and S. Hong, "A wideband transformer-coupled CMOS power amplifier for X-band multifunction chips," IEEE Trans. Microw. Theory Techn., vol. 59, no. 6, pp. 1599–1609, Jun. 2011.