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on Semiconductor and Electronics, Information and Communications Technology and Energy

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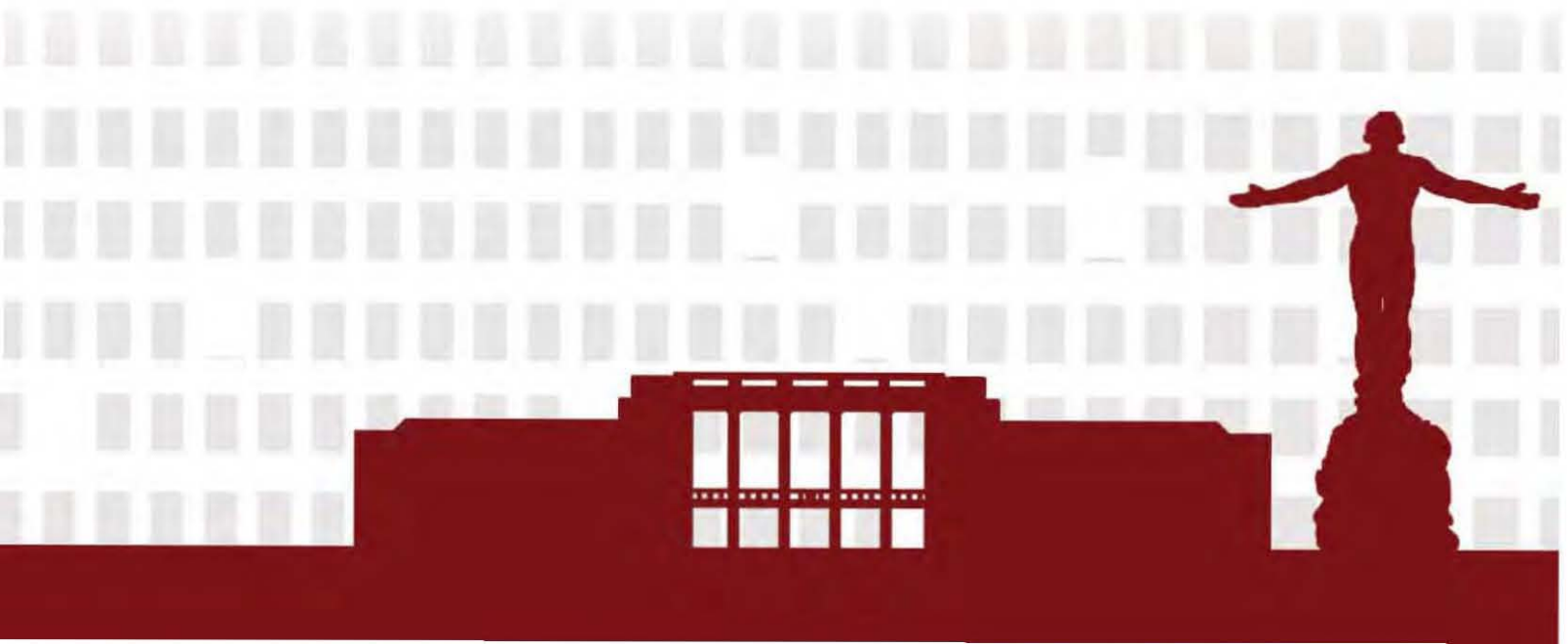
Metro Manila, Philippines



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DESIGN OF A LOW POWER, AND FULLY-INTEGRATED 2.4GHZ ON-OFF KEYING TRANSMITTER FOR WIRELESS SENSOR NETWORKS

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ABSTRACT

Operating in a wireless sensor node environment (WSN) powered by energy harvesting requires low power operation and robustness to process, supply voltage, and temperature (PVT) variations [1]. For a transmitter integrated in a system-on-chip, low power operation is enabled in this work by using a suitable direct modulation on-off keying (OOK) transmitter architecture [2]. Tuning [3],[4], and detection [5] of carrier frequency accuracy is added to allow calibration to the target frequency of operation.

A differential cross-coupled oscillator topology is used for the carrier generation since this requires smallest transconductance, and therefore power, for oscillation [4]. A class AB power amplifier (PA) with tapped capacitor matching is chosen for easier integration and lower drive power, and hence low overall power for the transmitter output stage [6]. Similar implementation in literature [7], with the exception of external matching passives, achieved 25% transmitter power efficiency. To achieve similar efficiency with the target carrier frequency accuracy, given full integration of the matching network, design considerations for each block are presented in this work.

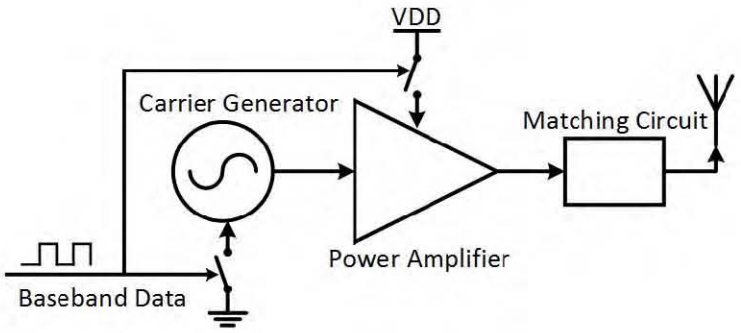

Figure 1. OOK transmitter block diagram

Through oscillator frequency tuning, the desired carrier frequency is achieved thereby improving the power efficiency of the transmitter to 25% at an output power of 0dBm. The designed oscillator is capable of 10MHz frequency steps for a 25% tuning range or 600MHz of frequency deviation from the target 2.4GHz.

To utilize the designed on-chip frequency calibration, an on-chip voltage domain PVT detection architecture, shown in Fig. 2, for the oscillator carrier frequency [5] is explored. Initial investigation on the circuit implementation shows that the achievable 2

accuracy for the frequency sensor is significantly dependent on the accuracy of the on-chip capacitances, switches, and current reference used in the frequency sensor block [5]. The design of this frequency calibration block is still on-going to improve the overall accuracy of the frequency sensor currently examined.

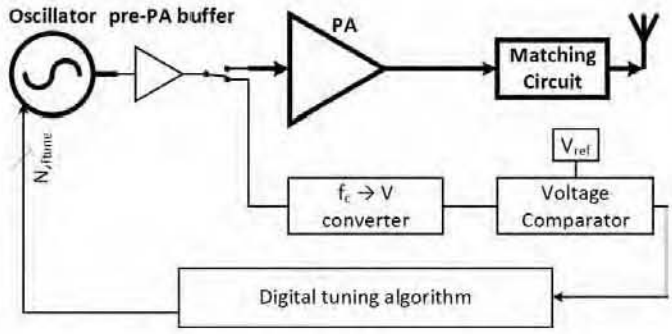

Figure 2. On-chip frequency tuning

Keywords: Fully-integrated, Low-power, Transmitter, Tuning, WSN

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