

**UNIVERSITI TEKNOLOGI MARA  
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**VOLTAGE CONTROLLED OSCILLATOR (VCO)  
FOR HIGH FREQUENCY BAND PHASE LOCKED  
LOOP (PLL) USING 45nm CMOS TECHNOLOGY**

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## **AUTHOR'S DECLARATION**

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

This research focuses on the development of a Voltage-Controlled Oscillator (VCO) optimized for high-frequency applications, utilizing 45nm CMOS technology to achieve a wide tuning range, low phase noise, and high-power efficiency. The study investigates two oscillator architectures Ring Oscillators and LC-Tank Oscillators to address design challenges and establish performance benchmarks for advanced communication systems requiring precise and reliable frequency generation. A full custom design flow was employed using Cadence Virtuoso to simulate and optimize the circuits. Key analyses, including transient and periodic steady-state (PSS) simulations, were conducted to evaluate oscillation frequencies, phase noise, and power consumption under varying design parameters. The results indicate that Ring Oscillators offer broad tuning ranges and lower power consumption but suffer from higher phase noise, while LC-Tank Oscillators provide superior frequency stability and reduced phase noise at the cost of increased power consumption. The study also highlights the influence of transistor sizing and LC circuit configurations on oscillator performance. Ultimately, the findings demonstrate that LC-Tank VCOs are better suited for high-frequency communication systems due to their stability and precision. This research underscores the critical need to balance power efficiency, phase noise, and tuning range in VCO design to meet the stringent requirements of modern electronic applications.

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