AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Electronics and Communications Engineering Department

A Delta-Sigma Fractional-N frequency synthesizer

A Thesis

Submitted in Partial Fulfillment of the Requirements

For the Degree of Master of Science in Electrical Engineering

(Electronics and Communications Engineering)

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STATEMENT

This dissertation is submitted to the Faculty of Engineering, Ain Shams University for the degree of Master of Science in Electrical Engineering (Electronics and Communications Engineering).

The work included in this thesis was carried out by the author at the Electronics and Communications Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis was submitted for a degree or a qualification at any other university or institution.

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Thesis Title: Delta-Sigma Fractional-N frequency synthesizer
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ABSTRACT

In this thesis, a Delta-Sigma Fractional-N frequency synthesizer using a phase selection approach is designed. This approach aims at decreasing fractional spurs that appear when using fractional-N frequency synthesizers. The phase selection approach is a method to carry out fractional division by toggling between different fractional division ratios. The average of these fractional division ratios is equal to the required fractional division ratio. Eight signals, shifted in phase by $\frac{\pi}{4}$, are generated from the output of the frequency synthesizer using a phase generator. Each reference cycle, a fractional division ratio is achieved by selecting one of the eight signals. A MASH 1-1-1 Delta-Sigma modulator is used to control the phase selection process. The difference between two successive fractional division ratios at two successive reference cycles corresponds to the difference between two successive output values of the Delta-Sigma modulator at the same reference cycles.

This approach was designed using 130nm TSMC design kit and a supply voltage of 1.5 volts. It was able to achieve better results than those

of the conventional fractional-N frequency synthesizers regarding phase noise and fractional spurs.

Key Words:

Fractional-N frequency synthesizer, integer-N frequency synthesizer, MASH 1-1-1 Delta-Sigma modulator, phase locked loop, LC-voltage controlled oscillator, phase frequency detector, charge-pump, phase generator, phase selection, fractional spurs, phase-noise, fractional division.

To my dear mother, Azza Abu Gabal

With all my love and gratitude

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