

Preface

One of the challenges in implementing a frequency synthesizer for Multiband OFDM Ultra Wideband (MB-OFDM UWB) is overcoming the agility limitations of conventional synthesizers. The MB-OFDM proposal for UWB divides the spectrum from 3.1 to 10.6 GHz into 14 different bands, and frequency hops at the rate of 3.2 MHz between them with a specified frequency settling time of only 9.5 ns. Design techniques that eliminate the use of on-chip inductors, and which are compatible with low-voltage operation, are critical for increasing the level of integration for future implementations.

An inductor-less design methodology may have several advantages over traditional design techniques: (1) While the area required to implement an on-chip inductor does not scale down in the finer technology nodes, inductor-less designs benefit from technology scaling. (2) On the other hand, the quality factor of the on-chip inductors may worsen in finer technology nodes, which can lead to an increase in the required current consumption to generate a given voltage swing. (3) It is more straightforward to port an inductor-less design into a new technology node. The penalty for an inductor-less design methodology is a slightly increase in the current consumption to achieve the necessary gain and voltage swing in the absence of inductors.

In this work, a frequency plan is proposed that can generate all the required frequencies from a single fixed frequency and can implement any center frequency with a maximum of two levels of SSB mixing. In order to generate all the required frequencies for the operation of this frequency synthesizer out of a single frequency, fractional frequency dividers are needed. Therefore, a study is performed on the architectures that can obtain a fractional division ratio. This study involves an analysis of the operation, stability, and phase noise of injection-locked regenerative frequency dividers. In addition, the operation, stability, locking range, and phase noise of two-stage ring-oscillators, which are compact ways to generate quadrature output phases and can be used in injection-locked regenerative frequency dividers, are analyzed.

This work presents the first CMOS inductor-less single PLL 14-band frequency synthesizer for MB-OFDM UWB which is capable to perform any arbitrary band

switching specified in less than 2 ns. Implemented in a 0.13 μm CMOS process, it uses a single 1.2 V supply voltage, and dissipates 135 mW. The mixing sideband level is better than -31 dBc and the phase noise is better than -110 dBc/Hz at 1 MHz offset.

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Fast Hopping Frequency Generation in Digital CMOS

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2013, XIV, 154 p., Hardcover

ISBN: 978-1-4614-0489-7