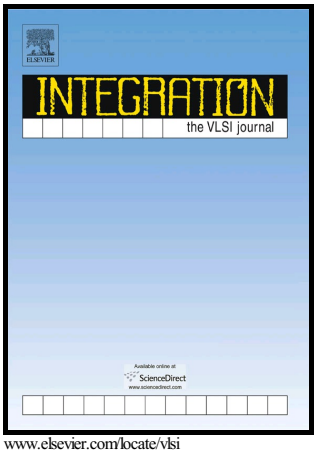
Author's Accepted Manuscript

Low-loss active inductor with independently adjustable self-resonance frequency and quality factor parameters

H.G. Momen, M. Yazgi, R. Kopru, A.N. Saatlo



www.elsevier.com/locate/vlsi

PII: S0167-9260(16)30229-2
DOI: http://dx.doi.org/10.1016/j.vlsi.2016.12.014
Reference: VLSI1290

To appear in: *Integration, the VLSI Journal*

Received date: 29 April 2016
Revised date: 21 December 2016
Accepted date: 30 December 2016

Cite this article as: H.G. Momen, M. Yazgi, R. Kopru and A.N. Saatlo, Low-loss active inductor with independently adjustable self-resonance frequency and quality factor parameters, *Integration, the VLSI Journal*, http://dx.doi.org/10.1016/j.vlsi.2016.12.014

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

Low-loss active inductor with independently adjustable self-resonance frequency and quality factor parameters

H.G. Momen[1], M. Yazgi[1], R. Kopru[2], and A.N. Saatlo[3]
[1] Istanbul Technical University, Faculty of Electrical-Electronics Engineering, 34469 Maslak, Istanbul, Turkey
momen@itu.edu.tr, yazgim@itu.edu.tr
[2] Isik University, Faculty of Electrical-Electronics Engineering, 34980 Sile, Istanbul, Turkey
ramazan.kopru@isikun.edu.tr
[3] Department of Electrical-Electronics Engineering, Urmia Branch, Islamic Azad University, Urmia, Iran
a.naderi@iaurmia.ac.ir

Abstract_ This work presents a new low-loss active inductor whose self-resonance frequency and quality factor parameters can be adjusted independently from each other. In order to achieve this property, a new input topology has been employed which consists of cascode structure with a diode connected transistor. Furthermore, the proposed input topology makes the device robust in terms of its performance over variation in process, voltage and temperature. Additionally, RC feedback is used to cancel series-loss resistance of the active inductor, which allows self-resonant enhancement as well. Schematic and post-layout simulation results show the theoretical validity of the design. To validate the design feasibility for process, voltage and temperature changes, Monte Carlo and temperature analysis are done. Suggested structure shows inductor behavior in the frequency range of 0.3-11.3 GHz. Maximum quality factor is obtained as high as 2.1k at 5.9 GHz. Total power consumption is as low as 1mW with 1.8 V power supply.

Keywords: Active inductor, CMOS, quality factor, self-resonance frequency, low-loss

Accepted manuscript

1. Introduction:

Inductors are inevitable parts of the electronic circuits especially in variety of communication and information processing applications. On the other hand, CMOS has been dominant technology to implement Integrated Circuit (IC) for almost three decades. Therefore, designers have tried to integrate inductors with this technology.

Since spiral inductors, implemented by CMOS, suffer considerably from both ohmic loss in metal and substrate loss due to the conductive silicon, so they typically exhibits the lowest quality factor. Another drawback of inductors on silicon is their excessive area coverage [1-3]. The limitations of standard CMOS spiral inductors have led researchers to consider a variety of alternatives such as Active Inductors (AIs) [4, 5]. Although plagued by higher noise and higher power consumption than their passive counterparts, AIs are theoretically capable of producing relatively high and tunable quality factors and inductance [6, 7].

Various analog architectures are suggested to emulate the electrical characteristics of inductor in literature [4-8]. However, the most famous topology which is used in designing AIs especially for high frequency applications, is Gyrator-C (GC) [9, 10]. Its popularity relies on the fact that gyrators transconductance can be adjusted with applied bias, thereby allowing for AIs whose value can be tuned electrically [9-11].

Designers do their best to improve Self-Resonance Frequency (SRF) and Quality Factor (QF), two main characteristics in term of AI performance [5]. In GC topologies, the input transistors play critical role in active inductor characterization. By selecting the input transistor's gate-source parasitic capacitance sufficiently small, then the SRF Range (SRFR) of AI improves but its QF and stability degrade. On the other hand, large input transistor guarantees the stability of AI and improves the inductance value and QF but decreases the SRFR [6]. Thus, there is a trade-off between SRF and QF.

Another main challenge for AIs designers is their ohmic loss which affect the QF. For decreasing this parasitic components many tricks are used such as Multi-Regulated Cascade stages [9, 10] or cross-coupled structures i.e. Negative Resistance (NR) [12-14]. But these methods are limited input swing and increased input referred noise. Also they need biasing transistors which makes the device larger.

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات