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A.	A. Youssef, J. Haslett and E. Youssoufian, "Digitally-controlled RF passive attenuator in 65 nm CMOS for mobile TV tuner ICs," Proceedings of 2010 IEEE International Symposium on Circuits and Systems, May 30 – June 2, 2010.

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11. A. Youssef, J. Haslett and E. Youssoufian, "Digitally-controlled RF passive attenuator in 65 nm CMOS for mobile TV tuner ICs," was published in Proceedings of 2010 IEEE International Symposium on Circuits and Systems. Proceedings of 2010 IEEE International Symposium on Circuits and Systems was held from May 30 – June 2, 2010. Copies of the conference proceedings were made available no later than the last day of the conference. The article is currently available for public download from the IEEE digital library, IEEE Xplore.

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Executed on: 5 November 2018

ATTACHMENT A

Digitally-controlled RF passive attenuator in 65 nm CMOS for mobile TV tuner ICs

3 Author(s)

Ahmed Youssef ; James Haslett ; Edward Youssoufian

View All Authors

Abstract:
A novel VHF/UHF passive attenuator linearization circuit suitable for mobile TV applications has been designed and implemented in 65 nm CMOS technology. The proposed attenuator has a wide gain range of 48 dB that can be digitally programmed in 3 to 6 dB steps. At every gain setting, the input and output of the attenuator are matched to 50 Ω 2 to facilitate its integration into mobile TV tuners.

Published in: Circuits and Systems (ISCAS), Proceedings of 2010 IEEE International Symposium on

Date of Conference: 30 May-2 June 2010

INSPEC Accession Number: 11463052

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SECTION I.
Introduction

Mobile TV is one of the latest features to be added to cell phones and other hand-held devices. The low cost, low power, and small size demands of this application have pushed researchers to use nanometer CMOS technologies in designing high performance tuner chip sets. The bulky RF filters (i.e., SAW filters) usually used in traditional TV-can tuners to suppress far-away interferer blockers are thus not an option for these integrated tuners. This results in tightening the linearity requirement of the RF front-end needed for mobile TV reception, and hence demands innovative design techniques to adhere to the low power necessities for this application [1].

The RF-AGC (Automatic gain control) technique has been proposed recently in the literature as one of the low power solutions that can help mobile TV receivers achieve their stringent linearity requirements [2][3][4]. Decreasing the RF gain at large input signal levels helps the receiver pass larger signals without any degradation in the output SNR (Signal-to-Noise Ratio). Although there

This paper proposes an RF attenuator linearization circuit used to vary the RF gain of mobile TV receivers while maximizing their dynamic range. The paper describes a passive attenuator designed, implemented in 65 nm CMOS technology and characterized in the lab. Additionally, a 5 bit linear thermometer decoder [5] integrated in the same test chip is used to program the gain of the attenuator. The decoder sets the gain value according to the signal level received at the attenuator input. Also, an on-chip programmable matching network is used to provide a stable 50 Ω input resistance to the mobile TV antenna for the entire gain range.

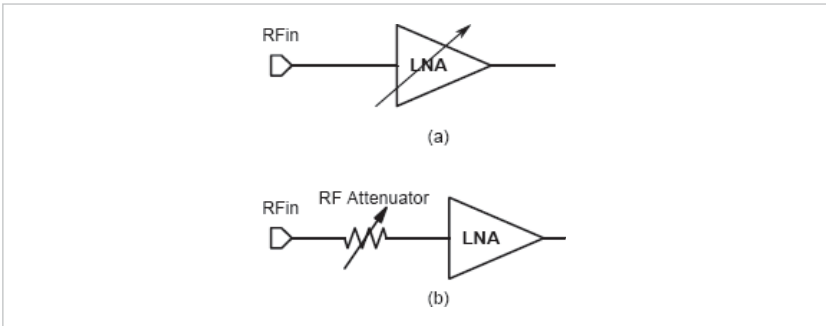

Figure 1. RF gain control through a) a variable gain LNA or through b) RF programmable passive attenuator

This paper is organized as follows. Section II discusses the advantages of using passive gain control over active gain control (i.e., Variable Gain (VG) LNA) to vary the RF gain of a mobile TV receiver. Section III presents the proposed RF attenuator design and demonstrates some practical issues dealt with in its integration with the rest of the mobile TV system. Measurement results are given in Section IV, and finally Section V draws the conclusions.

SECTION II.
Passive Gain Contol Versus Active Gain Control

There are several ways to achieve gain control in RF front-ends. Fig. 1a shows a VG-LNA used to control the RF gain, while Fig. 1b shows a programmable passive attenuator used to control the RF gain. Both techniques are capable of preventing a receiver from clipping at large input signal levels and, in theory, either one can be used to boost the linearity of a mobile TV tuner. However, the difference between them becomes clear when the receiver dynamic range (DR) is taken into consideration. Having the attenuator control (passive control) the RF gain results in a DR value that is far superior to that achieved when gain is controlled by a VG - LNA (active control), especially at the higher attenuation (lower gain) settings.

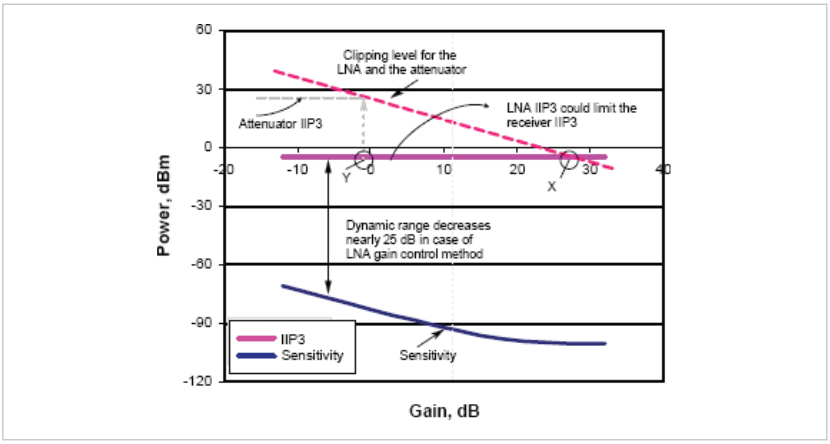

Figure 2. Simulation results show the impact of using the active gain control method versus the passive gain control on a receiver dynamic range

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