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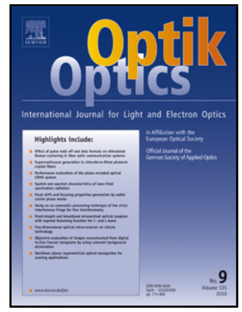

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Study of impact of voltage gain of comparator on performance of newly designed functional generator

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Abstract

This paper focuses on analysis of impact of voltage gain of comparator on features of designed triangular and sine wave generator. Newly designed generator employs minimal number of passive and active components based on simple voltage controllable amplifier and electronically controllable current conveyor or adjustable current amplifier. The generator has simple structure with easily available electronic control of repeating frequency and duty cycle. Detailed PSpice analyses of the modified generator are provided and relevant results of experimental measurements are shown. Discussion of non-ideal effects of voltage gain (A) of controllable amplifier used as comparator on generated amplitudes, on repeating frequency and on duty cycle as well as effects of statistical dispersion of important parameters are given. Observed behavior was analyzed not only by simulations but also by experimental measurements.

Keywords: Controllable current gain, electronic control, electronically controllable current conveyor, gain adjusting, voltage controllable amplifier, triangle and square wave generator.

1. Introduction

Electronic control of parameters in frame of active element [1] is very important for applications that require variable features. Applications that we discuss in this paper focus on triangle and square wave generators based on well-known solution [2] that is formed by loop connection of lossy integrator and comparator with two thresholds/hysteresis (so-called Schmitt trigger) [2]-[4]. Classical approaches employing operational amplifiers [2] are not very feasible because their controllable features are very restricted (only replacement of resistor in integrator by controllable equivalent) and complexity (number of passive elements - at least 3 resistor and floating capacitor) is higher in comparison to solutions utilizing other active devices as will be discussed in further text. Using of other active elements [1] allow us to obtain applications with simple control of their parameter(s).

Many solutions of generators in simple form based on modern active elements are available in recent literature [1]-[24]. The following text represents brief discussion of their complexity and building active elements used. Single current differencing transconductance amplifier (CDTA) and three resistors together with grounded capacitor create simple solution presented by Biolek et al. [5]. De Marcelis et al. [6] used two current conveyors of second generation (CCIIs) and six resistors together with floating capacitor in their topology. Two differential voltage current conveyors (DDCCs) complemented by three resistors and grounded capacitor are typical for solution introduced by Chien et al. [7]. Almashary et al. [8] contributed by simplified topology employing two CCIIs, three resistors and two grounded capacitors. Further simplification (also based on two CCIIs, three resistors and only one floating capacitor) was proposed by Pal et al. [9]. Circuit based on two current feedback operational amplifier (CFOAs) including four resistors and floating capacitor that was developed by Haque et al. [10] bring another benefit (low-impedance outputs). Two operational transresistance amplifiers (OTRAs) also offer features for design of generators as shown by Lo et al. [11] in topology utilizing three floating resistors and capacitor. Minaei et al. [12] tested combination of CFOAs and DVCCs in these constructions. All already discussed works