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A Current-mode Square/Triangular ware Generator based on Multiple-output VDTAs

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Abstract

This article presents the square/triangular wave generator based on multiple output voltage differencing transconductance amplifiers (MO-VDTAs). The circuit topology is simple, consists of only two MO-VDTAs and a few grounded passive components. The features of the proposed circuit are that, its amplitude and frequency can be independently controlled by bias current of the MO-VDTAs, which is not dependent on power supply level. The PSpice simulation results are depicted that they agree well with the theoretical analysis. The total power consumption is approximately 14.3mW at ±1.5V power supply voltages.

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Keywords: Square/triangular wave generator, MO-VDTA

1. Introduction

A square/triangular wave generator is extensively used in communication systems, instrumentation and analog signal processing applications. Hence, the square/triangular wave generator was successively developed by different active blocks such as current conveyors [1], CFOAs [2], OTRA [3]. However, these reported circuits suffer from some weaknesses, such as using of a floating resistor which is inappropriate to further fabricate in IC and lacking of electronic controllability of output magnitude and frequency [1-3].

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VDTA is an active building block. This element was derived from the previously introduced current differencing transconductance amplifier (CDTA) [4]. This means that the VDTA is composed of the current source controlled by the difference of two input voltages and a multiple-output transconductance amplifier. The VDTA is very useful in electronic circuits such as oscillator [5], filters [4, 6-7], Schmitt trigger [8] and etc. Recently, the MO-VDTA was employed in a simple square wave generator circuit [9]. Unfortunately, it works in voltage-mode. The voltage-mode circuits also suffer due to the poor slew rate of the used active building blocks.

Presently, there is a growing interest in synthesizing current-mode circuits because of more their potential advantages such as larger dynamic range, higher signal bandwidth, greater linearity, simpler circuitry and lower power consumption [10-11]. In the point of view, the current–mode technique is ideally suited to this purpose more than the voltage-mode type.

Therefore, this paper presents a simple architecture of a current-mode square/triangular wave generator which is very simple by using only two MO-VDTAs with single grounded capacitor and two grounded resistors. The output frequency and amplitudes can be independently/electronically adjusted. Hence, it can be directly applied in an automatic control system via a microprocessor. The performance of circuit was proved by PSpice simulation and the results were correspondent in the theoretical analysis.

2. Basic concept of MO-VDTA

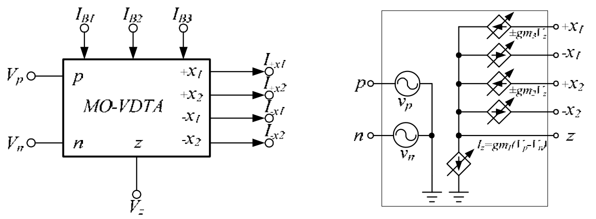
The MO-VDTA element is a simple active building block comprising transconductances section, as shown in Fig. 1. The characteristic and relationship of voltage and current are shown in Eq. (1)

$$\begin{bmatrix} I_z \\ I_{x1} \\ I_{x2} \\ I_{x3} \end{bmatrix} = \begin{bmatrix} g_{m1} & -g_{m1} & 0 \\ 0 & 0 & \pm g_{m2} \\ 0 & 0 & \pm g_{m3} \\ 0 & 0 & \pm g_{m4} \end{bmatrix} \begin{bmatrix} V_p \\ V_n \\ V_z \end{bmatrix}, \tag{1}$$

where g_{m1}, g_{m2}, g_{m3} and g_{m4} are transconductances of the MO-VDTA, which equal

$$g_{m1} = \frac{I_{B1}}{2V_T},\ g_{m2} = \frac{I_{B2}}{2V_T},\ g_{m3} = \frac{I_{B3}}{2V_T},\ g_{m4} = \frac{I_{B4}}{2V_T}. \tag{2}$$

V_T is the thermal voltage. The symbol and the equivalent circuit of the MO-VDTA are shown in Fig. 1(a) and Fig. 1(b), respectively.



(a) (b)

Fig. 1. The MO-VDTA (a) symbol (b) equivalent circuit

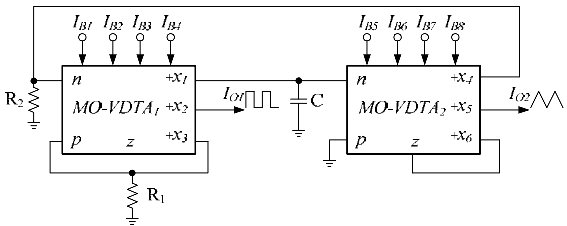


Fig. 2. The proposed square/triangular wave generator