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Four New Oscillators Using Operational Transresistance Amplifier

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Abstract—In this paper, four new sinusoidal waveform generators based on the operational transresistance amplifier (OTRA) are presented. The first proposed circuit is a minimum component RC sinusoidal oscillator circuit with one OTRA and a few passive components. The second and third proposed circuits consist of one OTRA and a few passive components, among them two passive components are connected to ground. These circuits are able to control the condition of oscillation and frequency of oscillation independently. The fourth proposed quadrature oscillator circuit uses two OTRAs as main active building blocks and a few external passive components to generate the oscillations. The IC AD844AN is adopted to implement the proposed circuits on a laboratory breadboard with external passive components. Both the SPICE simulation and experimental results are given to verify the theoretical analysis of the proposed circuits.

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1. INTRODUCTION

The sinusoidal oscillators have gained much attention due to its applications in the fields of electronic circuits such as signal processing, instrumentation and measurement, control systems and communication. Similarly, a quadrature sinusoidal oscillator typically provides two sinusoids with a 90° phase difference, which is useful in telecommunications for quadrature mixer, in single-sideband generators, in direct-conversion receivers, and also for measurement purposes in vector generators and selective voltmeters [1–4]. A variety of sinusoidal oscillator circuits have been proposed using op-amp as an active element in [1]. Although these oscillator circuits suffer from the limitations incurred by the limited slew rate and fine gain bandwidth product [1–5].

It is a known fact that several oscillator circuits have been proposed in the literature based on current mode devices to overcome the disadvantages posed by classical voltage-mode oscillators [6–28]. Current mode devices have gained considerable attention due to the large dynamic range, large frequency range and wider bandwidth compared to voltage mode devices.

In the literature several sinusoidal oscillators are available using current-mode devices like Current Feed-back Operational Amplifier (CFOA), Second Generation Current Conveyor (CCII), Operational Transconductance Amplifier (OTA), Differential Difference Current Conveyor (DDCC), Current Differencing Buffer Amplifier (CDBA) and Four Terminal Floating Noller (FTFN) [6–28]. These oscillators have shot into prominence due to the advantages gained over voltage mode oscillators. In the current mode oscillators, the oscillation frequency can be adjusted more accurately and the large slew rate compels the oscillation frequency less sensitive to the bandwidth variation of the active device. However, most of the circuits proposed in [6–28] have big number of passive components and more than one active component.

In the last decade, a new current mode device called an operational transresistance amplifier has gained considerable attention of the analog IC designers. The operational transresistance amplifier is a high gain current input and voltage output analog building block. Current differencing amplifier and Norton amplifier are the commercially available names of OTRA. These commercial realizations allow input current only in one direction and do not bear internal ground at the input terminal. These disadvantages are eliminated by the introduction of several high performance CMOS OTRA realizations [29, 30].

The OTRA has been used as an important building block in analog circuit design. Several circuit realizations [31–44] based on OTRA as main active building block like a square-wave generator,

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