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Novel grounded parallel inductance simulators realization using a minimum number of active and passive components

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ABSTRACT

In this paper novel lossless and lossy grounded parallel inductance simulators are reported. All grounded inductor simulator circuits employing only a single DXCCII and three passive components are proposed. The proposed topologies realized all grounded parallel inductance variations. To demonstrate the performance of the presented DXCCII based parallel inductance simulators, we used one of the circuits to construct a third order high-pass filter, a voltage-mode band-pass filter and LC oscillator. Simulation results are given to confirm the theoretical analysis. The proposed DXCCII and its applications are simulated using CMOS 0.35 μm technology.

1. Introduction

The current-mode active devices have many advantages such as greater linearity, lower power consumption, wider bandwidth, higher accuracy and better dynamic range than their voltage-mode counterparts and operational amplifiers [1–3]. Inductance leads to various problems in the electronics circuits and systems. In particular inductance simulators are widely used instead of inductance at high frequencies. The reasons are, it spreads the magnetic energy, it includes more parasitic than the other elements and it places a bigger footprint in integrated circuits (ICs).

The proposed circuits in [4–8] use four second-generation current conveyors and three to four passive elements to realize a floating inductance simulator. Using two dual-output current conveyors (DO-CCIIs) and three passive elements, a circuit that can realize floating or grounded inductance is presented in Ref. [9]. Also a circuit for realising floating inductance with compensated series resistance using six plus-type current conveyors (CCII+s) is reported in Ref. [10]. The inductance simulators can be used in many applications [4–24] such as active filter design, oscillator design, analog phase shifters and cancellation of parasitic element. Psychalinos et al. [18] proposed floating general impedance converter (GIC) using four CFOAs and five passive components. Yuce [19] used single CFOA, two resistors and a capacitor. The proposed circuits do not realize all of types of inductance. In comparison with previous DXCCII based inductor simulator circuit [20], the number of active elements is reduced by one.

The main purpose of this study is to present novel grounded parallel immittance simulator topologies employing single dual-X current conveyor (DXCCII) that provides therefore further possibilities for the designers in the realization of analog signal processing circuits. In this paper five grounded parallel inductor simulator topologies employing only one DXCCII and three passive elements are presented. The proposed topologies require canonical passive components. Finally, using one of the proposed grounded inductance simulators, a third-order high-pass filter, a voltage-mode band-pass filter and LC oscillator are constructed. All simulation results are included to verify the theory.

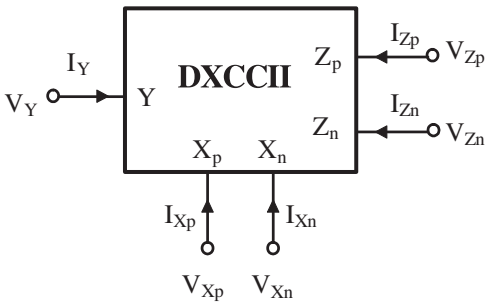

Fig. 1. Symbol of the DXCCII.

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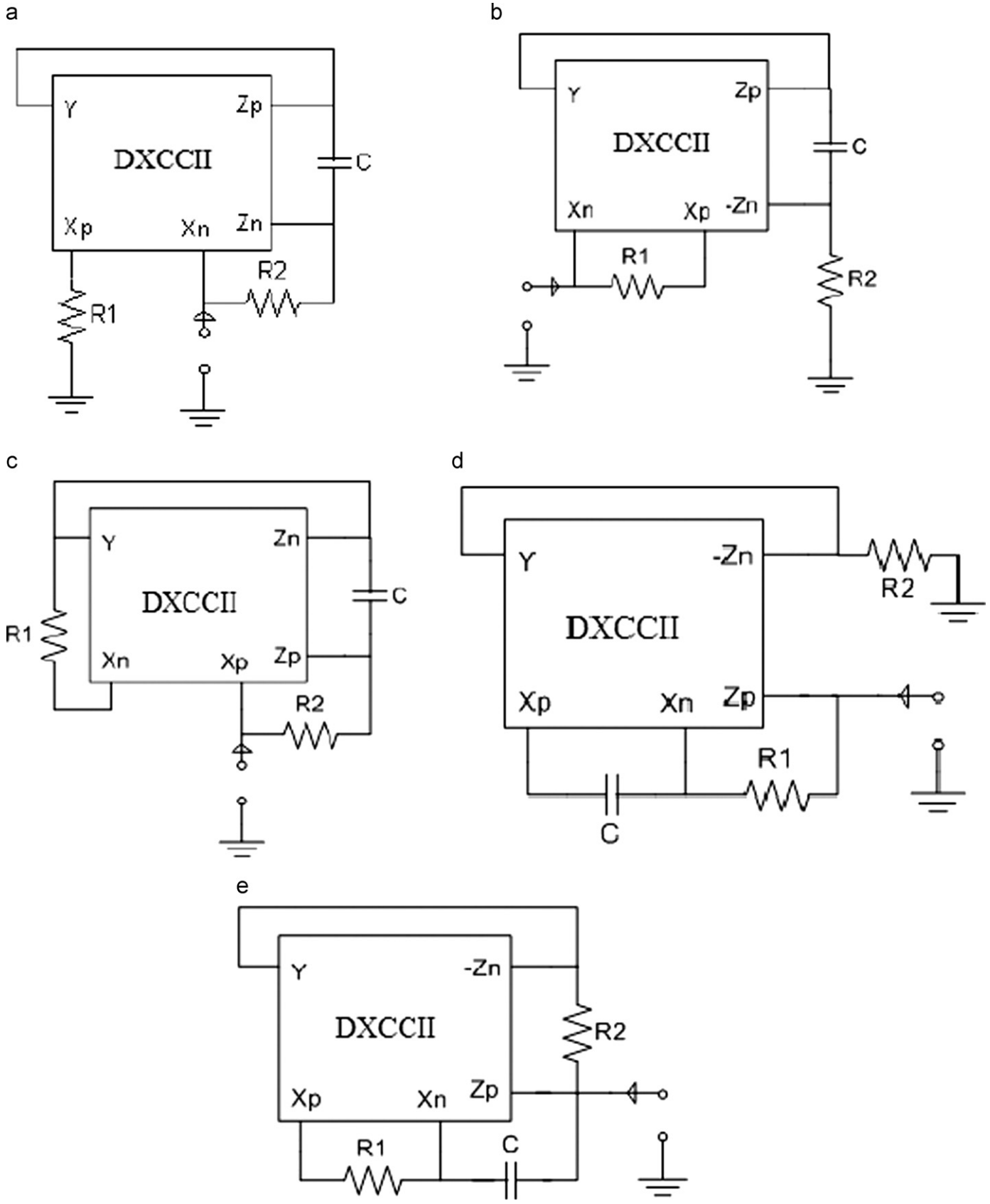

Fig. 2. Inductance simulators realized using single DXCCII.