

An Active-Only Temperature-Insensitive Current-Mode Biquad Filter Based on Differentiator Structures Employing CCCCTAs

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ABSTRACT

This article presents an active-only current-mode universal biquad filter performing three standard functions: low-pass, high-pass and band-pass function, which can be readily modified to achieve the rest functions (band-stop and all-pass). The circuit principle is based on active-only circuit designed by using differentiators which are constructed from current controlled current conveyor transconductance amplifier (CCCCTA) cooperating with an internally frequency compensated operational amplifier (OA). The features of the circuit are that: the pole frequency and quality factor can be independently tuned via the input bias currents and it is ideally temperature-insensitive, its circuit description is very simple, consisting of 3 CCCCTAs and 2 operational amplifiers, and the proposed circuit is very appropriate for further developing into integrated circuit architecture. The PSpice simulation results are shown. The given results agree well with the theoretical anticipation.

Keywords: Active-Only; CCCCTA; Current-Mode; Biquad Filter

1. Introduction

An analog filter is an important building block, widely used for continuous-time signal processing. It can be found in many fields: including, communications, measurement, instrumentation, and control systems [1,2]. One of the most popular analog filters is a universal biquad filter, since it can simultaneously provide several functions in the same circuit topology. Recently, a universal filter working in current-mode has been more popular than the voltage-mode type. Since last two decades, there has been much effort to reduce the supply voltage of analog systems. This is due to the demand for portable and battery-powered equipment. Since a low-voltage operating circuit becomes necessary, the current-mode technique is ideally suited for this purpose. Actually, a circuit using the current-mode technique has many other advantages, such as, larger dynamic range, higher bandwidth, greater linearity, simpler circuitry and lower power

consumption [3,4].

The synthesis and design of analog signal processing circuits using only active elements without passive elements are important in fully integrated circuit (IC) technology. This technique makes circuit becoming smaller chip area, lower power consumption, wider frequency range of operation and programmability [5-8], where the applications can be easily seen in many literatures, for example filter [7], oscillator [9], inductance simulator [10] and etc.

From the past, creation of differentiator circuit must use an inductor worked together with an active element which affected on circuit as large sized. So, it was not popular to create circuit with differentiator. But nowadays, we can design differentiator-based circuit without any inductor, then causing a reduction in circuit sized smaller than creation circuit in the past. Biquadratic transfer function is widely used in order to synthesize the filters. Many kinds of filters can be realized based on only integrators as building blocks [11-14]. However,

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