

# CMOS Current-Mode Implementation of Fractional-Power Functions

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## Abstract

A CMOS current-mode circuit, with only eight transistors and two current sources, is proposed to implement a fractional power function. The compact circuit comprises of an approximating logarithm circuit and an approximating exponential circuit. By sizing one transistor and tuning one current source, we improve the truncation errors in the Taylor series approximation, and reduce the MOS square-law errors that are caused by second-order effects. As example, a circuit, designed for gamma correction, with different gamma values controlled by three switches, is fabricated using  $0.35 \mu\text{m}$  CMOS technology. The demonstration circuit can achieve a bandwidth of 155 MHz for an input range from  $40 \mu\text{A}$  to  $130 \mu\text{A}$  with 3% error, and maximum power dissipation of approximately  $970 \mu\text{W}$ .

Keyword : Current-mode circuit, Square-rooting circuit, Cube-rooting circuit, Analog computational circuit, Taylor series approximation