

高精度 Sigma-Delta 调制器的建模设计

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摘要: 基于 MATLAB Simulink 设计实现了一款单环三阶一位量化 CIFF(Cascade-of-integrators, feedforward form)结构的高精度 Sigma-Delta 调制器.通过对噪声传输函数和系统反馈系数进行优化,提高了调制器的稳定性;分析了开关电容电路的主要误差影响,为电路实现提供可靠的设计指导.仿真结果显示,在输入信号带宽为 75 Hz,过采样率为 512 时,理想调制器输出 SNR 高达 148.3 dB, ENOB 为 24.34 bit;考虑非理想因素时, ENOB 为 22.02 bit;电路级实现的调制器 ENOB 达 20.94 bit,表明该设计可实现低信号带宽下高精度转换.

关键词: Sigma-Delta 调制器; 高精度; CIFF; 噪声传输函数; 非理想因素

The Modeling Design of High-precision Sigma-Delta Modulator

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Abstract: Based on the MATLAB Simulink, the design of high-precision Sigma-Delta Modulator with single-loop third-order one-bit structure of CIFF is realized. The noise transfer function and feedback coefficients are optimized to enhance the stability of the system; and the main non-ideal factors in switch capacitor circuit are analyzed to provide a reliable guidance for transistor level circuit design. The simulation results show that when the signal bandwidth is 75 Hz and the sampling rate is 512, the SNR is as high as 148.3 dB; the ENOB is 24.34 bit and become 22.02 bit in the condition of various non-ideal factors, and become 20.94 bit when the designed modulator is realized by the real circuit. The results show that this structure can achieve high accuracy under low signal bandwidth.

Key words: Sigma-Delta Modulator; high precision; CIFF; noise transfer function; Non-ideal factors

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