

基于压缩传感的模数转换器设计

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摘 要: 随着宽带信号应用的普及, 压缩传感理论打破了传统奈奎斯特模数转换器在硬件上的瓶颈. 设计了一款基于压缩传感理论的模数转换器, 并提出了一种针对多路并行结构、压缩传感信号重构的校准方法. 系统在 180 nm 工艺下进行电路和版图设计. 设计指标是基于压缩传感利用低于信号奈奎斯特频率的模数转换器达到 160 MHz 采样频率, 12 bit 量化精度. 经校准的整体后仿指标达到 160 MHz 10.25 bit, 核心面积为 2.08 mm², 优值(FOM)为 110 fJ. SAR 模数转换器后仿指标达到 40 MHz 10.08 bit, 优值(FOM)为 56 fJ. 在整体上验证了设计结构和算法的正确性和有效性.

关键词: 压缩传感; SAR; 电容失配; 宽带

中图分类号: TN4

文献标识码: A

文章编号: 1000-7180(2016)02-0007-05

Design of an ADC Based on Compressed Sensing Theory

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Abstract: As the wide band signal application popularizing, traditional ADC based on Nyquist sampling theory is limited, which can be conquered by compressed sensing theory. This paper presents an ADC based on compressed sensing theory, and put forward a calibration method to estimate the mismatch of multipath when reconstructing the original signal from compressed sensing measurement. The whole system is implemented in UMC 180 nm fabrication. It consists multipath to measure the input signal but quantized by a single quantizer. The quantizer is a SAR ADC which can work individually. The object is to design an ADC achieving 160 MHz sampling frequency and 12 bit ENOB with a sub-Nyquist quantizer. The whole system achieves a post-layout 160 MHz 10.25 ENOB with a figure of merit of 110 fJ/conv-step, and occupies 2.08. The SAR ADC achieves a post-layout 40 MHz 10.08 bit with a FOM of 56 fJ/conv-step. The simulation shows the correctness and effectiveness of the system structure and calibration method.

Key words: compressed sensing; SAR; capacity mismatch; wide bandwidth

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