

SiGe HBT低噪声放大器的设计与制造

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Design and Fabrication of SiGe HBT Low Noise Amplifier

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摘要

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摘要 该文设计和制作了一款单片集成硅锗异质结双极晶体管(SiGe HBT)低噪声放大器(LNA)。由于放大器采用复合型电阻负反馈结构,所以可灵活调整不同反馈电阻,同时获得合适的偏置、良好的端口匹配和低的噪声系数。基于0.35 μm Si CMOS平面工艺制定了放大器单芯片集成的工艺流程。为了进一步降低放大器的噪声系数,在制作放大器中SiGe器件时,采用钛硅合金(TiSi₂)来减小晶体管基极电阻。由于没有使用占片面积大的螺旋电感,最终研制出的SiGe HBT LNA芯片面积仅为0.282 mm²。测试结果表明,在工作频带0.2-1.2 GHz内,LNA噪声系数低至2.5 dB,增益高达26.7 dB,输入输出端口反射系数分别小于-7.4 dB和-10 dB。

关键词: 硅锗异质结双极晶体管 低噪声放大器 单片集成 噪声系数

Abstract: A monolithic SiGe Heterojunction Bipolar Transistor (HBT) Low Noise Amplifier (LNA) is designed and fabricated in this paper. Composite resistance feedback loops are adopted in this amplifier. Hence, reasonable bias conditions, good port matching and low Noise Figure (NF) are achieved simultaneously by adjusting different feedback resistor smartly. Based on the 0.35-μm Si CMOS technology, the fabrication processes for monolithic amplifier integrated chip are developed. In the fabrication process of SiGe devices, base resistance of transistor is reduced by using titanium silicon (TiSi₂) deposition in order to further decrease the NF of LNA. Finally, die area of this monolithic LNA is only 0.282 mm² due to the absence of spiral inductor which occupies most of chip area. The measurement results indicate that, in the band from 0.2 to 1.2 GHz, this LNA achieves the minimum NF of 2.5 dB, the maximum gain as high as 26.7 dB, and the input and output reflections (S₁₁, S₂₂) of less than -7.4 dB and -10 dB, respectively.

Keywords: SiGe Heterojunction Bipolar Transistor (HBT) Low Noise Amplifier (LNA) Monolithic integration Noise Figure (NF)

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