Substrate Parasitic Extraction for RF Integrated Circuits

Andreia Cathelin, Youri Leclercq*, Daniel Saias, Didier Belot, and Francois J. R. Clément*.
STMicroelectonics, 850, rue Jean Monnet, F-38926 Crolles Cedex. *Simplex Solutions.

Abstract

Accurately predicting the impact of substrate parasitics in Radio Frequency design with simulations is one of the major concerns to ensure first silicon success in a System on Chip approach.

The practical design experience of a 2GHz RF front-end circuit (designed in a 0.35 μm SiGe Bicmos technology), presented here, illustrates how measurements results can be accurately predicted using a substrate parasitic extractor.

1. Introduction

Smaller feature sizes and higher densities, combined with higher frequencies, and lower supply voltages of today's complex deep submicron Radio Frequency designs have made substrate noise coupling a key issue for any design flow targeting first silicon success. This approach was validated on a test chip consisting in a Low Noise Amplifier and a Down Conversion Mixer for a superheterodyne mobile phone receiver.

2. Experimental results

The RF signal (1980 MHz) and the Local Oscillator (2160 MHz) were fixed at -25 dBm and -14 dBm respectively. The output spectrum of the mixer was both simulated and measured. This spectrum not only contains the mixing product at 180 MHz but also products of non linearities and intermodulation which may hinder the system functionality. As shown in figure 1, in order to obtain simulation results consistent with the measurements results, the substrate model has to be taken into account. The simulation accuracy then enables the designer to confidently meet the block specifications.

3. Conclusion

A design flow including substrate parasitic modelling based on efficient extraction tools allows the designer to efficiently address substrate coupling issues in RF Integrated Circuits. This approach reduces significantly the design cycle.

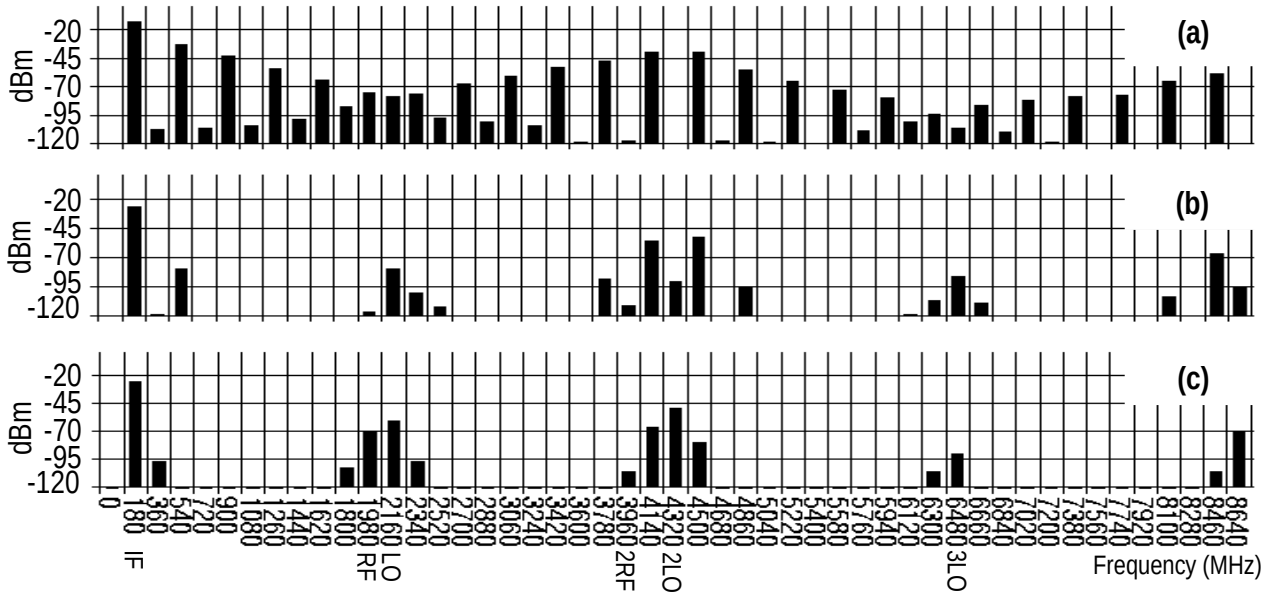

Fig 1: Spectrum of the Intermediate Frequency signal at the output of the mixer from simulation with no substrate model (a), simulation including substrate parasitics (b) and measurement (c).

Proceedings of the 2002 Design, Automation and Test in Europe Conference and Exhibition (DATE'02)
1530-1591/02 $17.00 © 2002 **IEEE**