Bandpass Sigma Delta Modulator for wireless applications in TSMC 0.25 um process

Project Description :

The aim of this M.S. thesis project is to design a Bandpass Sigma Delta (SD) modulator for use in the baseband block of a Wideband Code Division Multiple Access (WCDMA)down conversion receiver. It has been determined that such an application would need 8 bits of accuracy, 50 dB SNR for a 2 MHz signal bandwidth over a 1 GHz carrier. From a functional viewpoint, the modulator consists of a direct conversion mixer and a low pass SD modulator. However due to the presence of the mixer, the modulator can accept band pass inputs. The low pass SD modulator has a 2nd order switch capacitor filter and a comparator in a feedback loop.The mixing and the filtering operations are performed using the above-mentioned filter. The output of the comparator (which is valid during one clock phase and is reset during the other clock phase) is then latched onto a D flip flop. This ensures that the outputs are valid during both the clock phases. For a better performance, fully differential structures have been implemented.

The circuit has been implemented in the TSMC 0.25um LOGIC Salicide 2.5/3.3V Process. The technology code for this process is TSMC25.

Estimated project size :

The entire project , including the pads, has been estimated to occupy a die area of 3 mm^2 i.e., 3 millimeter-square.

Simulation plans :

Initial modeling, simulation of the overall modulator was performed using Matlab and Simulink. Then the transistor-level blocks and the overall project were simulated using HSPICE in Cadence environment. Transient analyses were performed and the output spectrum was found to meet the desired specifications. The modulator also performed satisfactorily under all the process corners.

Test and Characterization plans :

The fabricated modulator would be tested using a Printed Circuit Board (PCB) to be designed for this purpose. The testing, characterization could then be performed in the Carver High-Speed Communications Circuits Laboratory in the Dept of Electrical and Computer Engineering, Iowa State University. This lab is well equipped with state-of-the-art test equipment including Spectrum / Network Analyzers, Signal Generators, Digital / Wide-Band Oscilloscopes, Multimeters, Power Supplies - suited especially for high frequency measurements. If need arises, the die can also be directly tested using the Wafer Probe Station.

Additional Information :

This project encompasses much of the M.S. thesis work of a half-time Research Assistant (the maximum employment allowed for full-time students), employed by the Electrical and Computer Engineering Department of Iowa State University. Any intellectual property developed as a result of this project is assigned to Iowa State. Although funds for the student's salary are derived from ultimately industrial support through the Analog and Mixed-signal Design Center here, there has been no request by any sponsor for this specific project and there are no expectations or understandings that this project or any derivative will be used in any form of a commercial undertaking by any party. (Indeed, no commercial

entity would have rights to do so.) Furthermore, without participation in this new MEP program, we seriously doubt that we could by any means afford to have this circuit fabricated.