Closing The Gap Between Process Development and Mixed Signal Design and Testing

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Recently the topics of Mixed Signal and System on a Chip (SOC) testing methodologies have been surfacing in the industry as new challenges for the Mixed Signal design and test communities. This is due to the industry push for deep submicron technology and the rapid increase in Mixed Signal and System on a Chip products, where analog and digital process and designs are converging on a single chip.

These new advances have generated a large gap between existing test tools and methodologies (Fault modeling, BIST, etc.) and the semiconductor industry strive for rapid new product development with a short time to market, driven by competition and short product life time.

Several sources have recommended new solutions and methodologies to improve the quality of Mixed Signal designs and test methodologies as well as addressing the issues of inadequate sort and final test analog tools and its high cost. Most of the proposed solutions are heavily relying on design solution to find the answers for today’s and tomorrow’s questions.

Very few, however, have paid attention to the overall steps required for product development (starting from the process development phase, Design, testing and qualifying a product) as a larger case study to find an adequate test and characterization techniques to address the challenges facing current and future industry needs for Mixed Signal products. While most of the current activities are focused on adapting existing techniques such as BIST, Fault Modeling, etc. to Mixed Signal design and testing; the process development phase (the longest in the overall product development cycle) have been ignored as an area of possible investigation to help address the current industry concerns.

In this presentation, we will discuss in details what are the requirements for a successful Process development strategy that is targeted for successful Mixed Signal products design, testing and qualification with minimal cost and quick time to market.

Unlike standard processes, which are developed and characterized to meet layout design rules and a limited set of DC parameters (Idsat, Vt, leakage, etc.), Mixed Signal Processes must be characterized, in addition, for Mixed Signal performance such as gain, speed, noise, cross talk, output impedance, and matching. Furthermore, in addition to having the standard structures required for process developments, the process development test chips must include a considerable number of wafer level, testable, properly routed, and library based Mixed Signal fundamental structures, building blocks, op amps, etc. This will insure that the process architecture is tuned and tested early for Mixed Signal application. Moreover, having these structures on the development test chips should provide enough statistical data and information on the basic Mixed Signal building blocks, and how to optimize their performance in parallel with process and device optimization. This also will enable designers to predict design performance even before the process is frozen. Having Mixed Signal structures on the process development test chips will also insure that some of these structures could be carried over to manufacturing, to insure production is well controlled for Mixed Signal performance, not just for some simple transistor DC and metal bridging parameters, in addition this should provide relevant structures for correlation between product sort, yield and Fab data. Besides, this strategy will provide a wealth of base line data for next generation Mixed Signal process and designs as current generation Mixed Signal structures should also be laid out with tighter design rules to give a look ahead indication of their performance when new process development is carried out. These steps could provide tremendous saving in silicon starts and time to qualify several generation and products.

For time to market and SOC Designs, testing should start at the wafer level and early on during Process development phase. In order for this to take place, the industry and tool vendors should start addressing a new concept such as “process development for Mixed Signal testing” as a parallel to design for testing.