

A Continuous-Time Laser Programmable Analog Array for Radiation Environments

Anthony L. Wilson
Mission Research Corporation
513-851-3941
E-mail: awilson@mrcmicroe.com

Ji Luo, Joseph B. Bernstein, J. Ari Tuchman, Hu Huang, Kuan-Jung Chung

ABSTRACT

While interest, availability and use of FPAA's have grown, FPAA's still have not achieved the same success as FPGAs in the digital domain. This results from several contributing factors, including the lack of CAD tools, small circuit density, small bandwidth and layout dependent noise figures. These factors are all related to each other, making the design of a high performance FPAA a multi-dimensional problem. A critical reason behind these difficulties is the non-ideal programming technology, which contributes a large portion of parasitics into the sensitive analog system.

This paper presents the design of a high performance, radiation hard Laser Programmable Analog Array (LPAA) using LaserLink's MakeLink™ technology. Radiation hardness is achieved through the use of an advanced Silicon-on-Sapphire (SOS) fabrication process. The programming of the analog array is achieved through use of laser via formation, which has extremely low resistance, negligible capacitance and full compatibility with commercial CMOS processes. The proposed LPAA consists of a 4 x 2 array of Configurable Analog Blocks (CABs) surrounded by abundant interconnect resources. There are 12 PAD groups around the chip, and 8 tracks per X/Y channel. Each CAB has 4 input and 4 output pins with internal circuit operating in fully differential mode. With appropriate programming, the LPAA can provide an accurate, low-cost and rapid-prototyping analog ASIC solution.

Of interest in this design is the combination of various technologies to achieve an innovative design approach to a programmable analog array. Firstly, this paper will show the design flexibility of the array obtained through the coupling of the laser via technology with a fully balanced four terminal floating nullor (FBTFN) design. The paper will also show the architecture trade-offs taken in designing the analog array. Also the design of the programmable resistor array (PRA) and programmable capacitor array (PCA) will be addressed. Furthermore, the design of a unique routing algorithm for analog arrays will be introduced. Lastly, the development of the user interface in the Java programming language will be discussed.

SUMMARY

This paper reviews the design of a high performance radiation hard laser programmable analog array. It will discuss the use of laser via programming and its optimization process to obtain high reliability and low resistance interconnects. It will also discuss the analog array architecture design and routing algorithm, along with the user interface design.