A 16X16 Basic-Cell High Speed Silicon Germanium Field Programmable Gate Array

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ABSTRACT

The Field Programmable Gate Array (FPGA) is a configurable circuit consisting of logic blocks surrounded by a programmable routing structure. The routing cells and logic cells are programmed by memories whose data is provided by the configuration file of the CAD software to perform the desired functions. The first FPGA was introduced by Xilinx in 1985. Since then, FPGAs have become denser, cheaper and much more powerful in terms of performance and functionality than before. However, because FPGAs utilize switches to route signals to their neighbor circuits and the routing CMOS switches introduce more delay to the FPGA, thus reducing the overall performance, the operating frequency of the current commercial FPGAs has not increased as fast as the operating frequency of current ASICs.

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As high-speed systems are becoming more mature, the need for high speed reconfigurable systems is more urgent. But In order to improve the performance of an FPGA, many methods have been proposed. In the SiGe FPGA project, Silicon Germanium (SiGe) Heterojunction Bipolar Transistor (HBT) and Current Mode Logic (CML) are used to enhance the overall speed of the Basic Cell (BC) of the FPGA to compensate the performance reduction caused by interconnect wires and routing switches.

After successfully designing several FPGA chips with special programmed functions to test the performance of the basic cell, a large scale SiGe FPGAs has been designed and fabricated which contains a 16 x 16 Basic Cell array. The design methodology of Basic Cell, power rail, clock distribution and Voltage Control Oscillator (VCO) are included. Measured results showed its operating frequency can reach 12 GHz. Based on this design, a new version of 16 x 16 Basic Cell FPGA was fabricated with several functions updated and ready to test.