High Speed Adder Design using BiCMOS SiGe Technology

by

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ABSTRACT

For decades, CMOS has been the technology of choice for building fast and efficient computers. As CMOS transistor sizes continued to shrink, computers with ever-faster speeds continued appearing regularly. However, advances in clock rate have come less readily recently. This has initiated a trend towards multiple core microprocessors operating at slower clock rates. Hence, there is an opportunity to explore other technologies that might be used to build future computers with faster clock rates. Since, adders are essential component of the data path in any computer; we investigate the design of fast adders using SiGe Heterojunction Bipolar Transistors, which are currently the highest speed devices in silicon based circuit manufacturing.

The design and testing of these high speed 32-bit adders using IBM's 7HP and 8HP SiGe technology constitute the bulk of the work described in the thesis. Designs running at speeds up to 17 GHz have been recorded in 7HP, while speeds up to 26.7 GHz have been observed in 8HP circuits. With improvements in layout and temperature it is predicted that an 8HP 32-bit adder would be able to run at 32 GHz. This adder, in addition to a register file designed in the same technology would provide the basis for a CPU core running at speeds vastly superior to that of CMOS. Lower speed designs with significant power reduction are also discussed.