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THERMAL AWARE ENERGY EFFICIENT ALU DESIGN ON DIFFERENT FPGA

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Abstract:

Arithmetic logic unit (ALU) is one of the principal components of central processing unit (CPU) that performs arithmetic and logic operations. In this research, the main goal is to design energy efficient ALU through thermal approach. Two families of field programmable gate array (FPGA) are used to implement this design that includes 28 nm Artix-7 and 40 nm Virtex-6 FPGA. Different ambient temperature is used for this design. In this work, effect of both ambient temperature ($T_{ambient}$) and 28 nm FPGA on the power dissipation of ALU is analysed to create energy efficient design. For 100 MHz device operating frequency, there is 93.49% and 93.85% decrease in leakage power dissipation on 20°C (68°F) and 10°C (50°F) ambient temperature, when FPGA technology is scaled down from 40 nm to 28 nm. For 100GHz, there is 53.75% reduction in junction temperature on Vitrex-6 and 49.08% reduction in junction temperature on Artex-7. This paper is unique in the sense that it deals with effect of surrounding temperature on the power dissipation of the energy efficient ALU. In this work, 76 linear meter per minute (LMM) (250 ft/min) airflow and medium profile hit sink are also considered before calculating the power on given ambient temperature.

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