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On Process Variation Tolerant Low Cost Thermal Sensor Design

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Abstract

Thermal management has emerged as an important design issue in a range of designs from portable devices to server systems. Internal thermal sensors are an integral part of such a management system. Process variations in CMOS circuits cause accuracy problems for thermal sensors which can be fixed by calibration tables. Stand-alone thermal sensors are calibrated to fix such problems. However, calibration requires going through temperature steps in a tester, increasing test application time and cost. Consequently, calibrating thermal sensors in typical digital designs including mainstream desktop and notebook processors increases the cost of the processor. This creates a need for design of thermal sensors whose accuracy does not vary significantly with process variations. Other qualities desired from thermal sensors include low area requirement so that many of them maybe integrated in a design as well as low power dissipation, such that the sensor itself does not become a significant source of heat. In this work, we developed a process variation tolerant thermal sensor design with (i) active compensation circuitry and (ii) signal dithering based self calibration technique to meet the above requirements in 32nm technology. Results show that we achieve 3ºC temperature accuracy, with a relatively small design which compares well with designs that are currently used.

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