Preface

This book presents a micro-power light energy harvesting system for indoor environments. Light energy is collected by amorphous silicon photovoltaic (a-Si:H PV) cells, processed by a switched-capacitor (SC) voltage doubler circuit with maximum power point tracking (MPPT), and finally stored in a large capacitor. The MPPT fractional open-circuit voltage (V_{OC}) technique is implemented by an asynchronous state machine (ASM) that creates and, dynamically, adjusts the clock frequency of the step-up SC circuit, matching the input impedance of the SC circuit to the maximum power point (MPP) condition of the PV cells. The ASM has a separate local power supply to make it robust against load variations. In order to reduce the area occupied by the SC circuit, while maintaining an acceptable efficiency value, the SC circuit uses MOSFET capacitors with a charge reusing scheme for the bottom-plate parasitic capacitors. The circuit occupies an area of 0.31 mm^2 in a 130-nm CMOS technology. The system was designed in order to work under realistic indoor light intensities. Experimental results show that the proposed system, using PV cells with an area of 14 cm^2, is capable of starting up from a 0 V condition, with an irradiance of only 0.32 W/m^2. After starting up, the system requires an irradiance of only 0.18 W/m^2 (18 $\mu W/cm^2$) to remain in operation. The ASM circuit can operate correctly using a local power supply voltage of 453 mV, dissipating only 0.085 μW. These values are, to the best of the authors' knowledge, the lowest reported in the literature. The maximum efficiency of the SC converter is 70.3 % for an input power of 48 μW, which is comparable with the reported values from circuits operating at similar power levels.

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