A Fully Integrated Low Input Voltage Self Starting Charge Pump Circuit for Boost Regulator Bootstrap Startup

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In the area of energy harvesting power electronics, recently published papers have shown that energy can be effectively scavenged from very low power input sources[1–8]. Unfortunately, due to the characteristics of their input sources, these power supply circuits must startup from a very low input voltage. While modern CMOS processes contain low- and zero-threshold voltage transistors that can address this requirement, these devices have large leakage currents. In order to maximize the total efficiency of the system, nominal threshold voltage transistors are required for the core of the regulator circuit. By using a startup circuit along with the core regulator using nominal devices, the converter is able to start up below the threshold of the nominal devices.

This paper introduces a circuit that can startup from a voltage of 240mV and produce a voltage level sufficient to commutate the nominal threshold power switches and bootstrap the regulator. Using a low power diode-type charge pump architecture and a built-in free running oscillator, our circuit can create an output voltage of 950mV under a realistic loading condition, while requiring no external components. The feasibility of our approach is shown with both lab bench and Spectre simulation results.

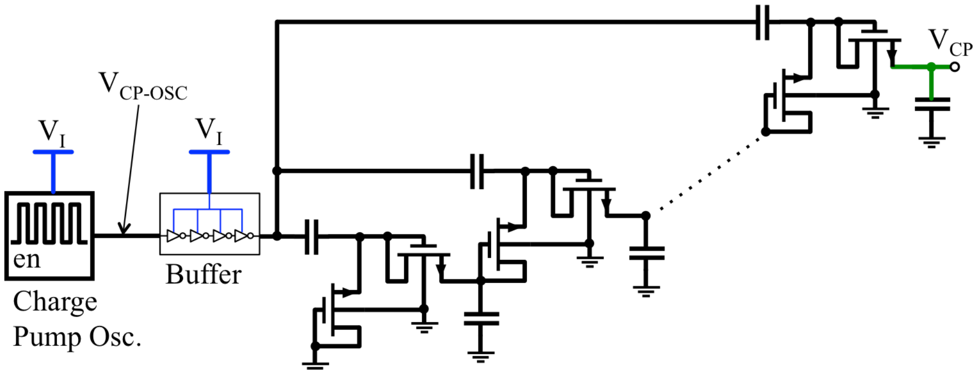

Fig. 1 Charge pump block diagram

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