Clock Power Reduction Utilizing Adiabatic Charging Method Via a Switched-Capacitor Circuit

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BACKGROUND

Normally, charging a capacitive load from a voltage source invokes a ½ CV^2 energy penalty. The concept of adiabatic charging, where the capacitor is charged more slowly than nominally afforded by the natural RC time constant of the charging circuit in the pursuit of reducing energy dissipation to below ½ CV^2, has been around for decades. However, there has not been any solution to enabling this slow charging phenomenon in a practical, low-overhead embodiment. For example, prior work used separate DC-DC converters to provide multiple voltage levels, or used resonant inductors, both of which invoke significant area overhead.

TECHNOLOGY DESCRIPTION

Researchers at UC San Diego invented a way to efficiently charges capacitive loads (e.g., clock trees, I/O pads, bio-electronic stimulators, etc.) via a step-wise adiabatic process. The present invention provides multiple levels in a small, efficient structure via a switched-capacitor approach to enable adiabatic charging for the first time in a practical solution. The technology was demonstrated in a clocking application.

APPLICATIONS

This invention has promising applications for any company doing digital design. Further applications include use in I/O drivers and neural stimulation.

ADVANTAGES

Efficient charging of capacitive loads in a minimized form factor.

STATE OF DEVELOPMENT

Complete, working prototype.

INTELLECTUAL PROPERTY INFO

A provisional patent has been submitted, the technology is available for licensing.

RELATED MATERIALS

▶ Loai G. Salem, Patrick P. Mercier. A 0.4-to-1V 1MHz-to-2GHz Switched-Capacitor Adiabatic Clock Driver Achieving 55.6% Clock Power Reduction ISSCC pp 442-444 2017 Feb 8,2017 - 02/08/2017

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,348,300	07/09/2019	2017-199

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OTHER INFORMATION

KEYWORDS

adiabatic charging, capacitive loads, clock trees, bio-electric stimulators, digital design

CATEGORIZED AS

- ▶ **Energy**
  - ▶ Storage/Battery
  - ▶ Transmission
- ▶ **Engineering**
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