A 10MHz Switched-mode power efficient neural stimulator

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ABSTRACT
Key requirements of implantable neural stimulators include size and reliability. The size can be reduced by making the system power efficient (i.e. smaller battery) and by reducing the number of external components. The latter option simultaneously increases the reliability.

This work presents a stimulator design that meets both goals by employing high frequency (10MHz) switched-mode stimulation. It combines two common system blocks, the DC-DC converter and the output stage, into a single system block. It therefore requires only one external inductor and the switched-mode operation ensures a high power efficiency: 100% theoretical efficiency and a 60% post-layout simulated efficiency over the full output range.

The circuit is implemented in AMS 0.18µ High Voltage Technology. The circuit design is based around a boost-converter and furthermore includes a duty cycle generator and some basic logic controlling the two independent output channels. The 3.5V input voltage is compatible with medical batteries and the output voltage can be as high as 10V.

Furthermore the current source output characteristic of the system makes charge cancellation easily implementable for safety reasons. Also the high frequency output signal was shown to be capable of achieving effective stimulation: a discrete component realization of the system was successfully tested in practice.