Circuit Design of Stimulus Driver for Adaptive Loading Applications

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The conventional stimulus driver circuits for the implantable devices have been presented in the literature. For example, a driver circuit can generate ~1-mA current pulses for stimulating the ~10-kΩ load at retinal layer. The other driver circuit with blocking capacitor can ensure the safe stimulation. These stimulus driver circuits are well designed to drive the load with constant impedance. Actually, for the application in the electrical stimulation of epilepsy control, the load impedance changes due to the variation of stimulus locations, cells, or other causes. This impedance ranges between tens of kΩ and hundreds of kΩ. This issue should be taken into consideration during the design phase of the stimulus driver circuit. A stimulus driver circuit with adaptability to generate constant stimulating current under various load impedance is needed for epilepsy control.

The novel design with the adaptability prevents from unexpected stimulus current for medical safety, since the safety is the prime concern for human use. The prototype of the stimulus driver circuit for microstimulator used in implantable device is presented in this paper. For epilepsy control, the target of the driver is to output 40-μA stimulus currents, as the tissue impedance varies within 20~200 kΩ. The driver composed of the output stage, current sensor, and control block, has been integrated in a chip. The averaged power consumption of the driver is only ~0.5 mW under 800-Hz stimulation rate. Fabricated in a 0.35-μm 24-V bipolar CMOS DMOS (BCD) process, the detailed performances of this novel design will be provided in the conference.

This work was partially supported by National Science Council (NSC), Taiwan, under Contract of NSC 98-2220-E-009-034; and by the "Aim for the Top University Plan" of National Chiao-Tung University and Ministry of Education, Taiwan.