

A Multifunctional, Embedded-based, Bluetooth-enabled, Programmable, Biphasic-waveform Stimulator with Real-time Neural Signal Acquisition

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Introduction

This work introduces a novel deep brain stimulator to explore changes at the molecular and behavioral levels in experimental animals. Although various micro-stimulator

Abstract

The study introduces a lightweight, Bluetooth-enabled deep brain stimulation (DBS) device that is designed specifically for preclinical research in small, freely moving animals. To address the current limitations in waveform flexibility and wireless control, we developed a compact, multifunctional stimulator capable of delivering programmable, charge-balanced biphasic waveforms while simultaneously acquiring neural signals. The system integrates off-the-shelf components for current regulation, signal amplification, and analog-to-digital conversion, all managed by a low-power microcontroller. The assembly includes key steps such as circuit integration on a double-sided 30 x 30 mm PCB, waveform programming via nRF Connect, and validation through saline and load resistance testing. *In vitro* assessments demonstrated reliable current output across varying load impedances, effective saline operation without waveform degradation, and high-fidelity neural signal recording with a signal-to-noise ratio exceeding 35 dB. These results confirm the device's suitability for closed-loop neuromodulation experiments and lay the groundwork for future translational studies in DBS therapy.

devices have been discussed in the literature, they vary significantly in size, weight, stimulation capabilities, ability to deliver prolonged stimulation, and the requirement for