Packaging Architecture for an Implanted System that Monitors Brain Activity and Applies Therapeutic Stimulation

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Abstract

Deep brain stimulation therapies for Parkinson's disease utilize hardware, which from a packaging perspective, resembles that used in cardiac pacemakers. A hermetic package that contains stimulation electronics and a primary battery supply is implanted under the scalp in a recess cut into the skull. Stimulation probes, each with up to four electrodes, are inserted into the brain and connected to the electronics package via a plug and cable system. By contrast, the closed loop neural stimulator being developed under the DARPA SUBNETS program utilizes probes, which each carry up to 64 electrodes that can be switched between recording and stimulation functions. This capability necessitates locating low noise amplifiers, switching and communication electronics in close proximity to each probe. Each of these satellite electronics packages requires ten electrical connections to the hub package, which significantly increases the complexity of the interconnect system relative to current practice. The power requirements of this system preclude the use of a primary battery supply so instead, a large lithium ion battery is used with a recharging coil and electronics. The hub system is fabricated as a separate connector header, electronics package and battery pack that are interconnected by a flex circuit to allow it to conform to the skull for implanting. In this paper, we will describe the various packaging components of the system and the design considerations that drove our technology choices.