

# UPSIDE

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## Executive Summary

The ability to perform brain stimulation with high-spatial resolution anywhere in the brain, while remaining minimally invasive, is of vital importance in the development of a new neuromodulation-based therapy for treatment resistant depression, and many other neurological disorders. Focused ultrasound is the optimal modality to achieve the abovementioned properties due to its excellent combination of depth of penetration, spatial resolution and reconfigurability. At the core of a focused ultrasound brain stimulation device, is the electronics that are capable of producing the electronic signals necessary to perform digital beam-steering and focusing: the ability to produce ultrasound waves that are focused in the three-dimensional space, and for which software can be used to adapt the focal spot location, in real-time and in the three-dimensional space. Beyond these properties, the electronics should also be compact such that it enables its deployment above the dura mater and below the skull, using minimally-invasive procedures. In particular, in the context of pre-clinical experiments with rat models of depression, compactness and high-spatial resolution are key, given the limited size of the brain. This deliverable reports on the development and electrical characterization of such electronic chip by exploring high-performance complementary metal-oxide-semiconductor (CMOS) technology, which is able to interface with a two-dimensional array of piezoelectric transducers exceeding 1024 elements with highly reconfigurable waveforms and driving voltages, while minimizing power-consumption.