An Additive Instantaneously Companding Readout System for Cochlear Implants

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Major Cochlear Implant manufacturers have included the possibility of recording neural responses. However, the possibilities are severely restricted due to the occurrence of saturation in the single channel amplifier and analog to digital converter (ADC), and the relative high noise levels. This is most clearly illustrated by the fact that objective neural thresholds are mostly found at the upper end of the subjective electrical dynamic range (Hughes, Brown, Lopez and Abbas, 1999). Recording on these relative high levels has as major drawback that different neural waveforms originating from different fibre populations are combined (Briaire and Frijns, 2005). Potentially the neural response data, thresholds, but also the spread of excitation and neural recovery functions, could provide insight in what the optimal stimulation strategy should be, and how to program the current levels of the implant for individual patients. Especially in very young children this should lead to increased performance. Researchers are now confronted with the limitations of existing neural response readout systems needed for reading out the evoked compound action potential (eCAP). These limitations urge the need for a new neural response readout system having a dynamic range of 126dB, that is small, low noise, power efficient and can handle input signals exceeding the supply voltage. Existing techniques do not offer solutions to meet the above specifications. An overall readout system design is proposed containing an additive instantaneous companding (a combination of compressing and expanding) input system, multiplexer, compensation circuit, amplifier and an ADC in order to record the eCAPs from the stimulated auditory nerve.