

ASIC Low-Power Signal Processing Circuitry for Esophageal ECG

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The E2corder is a new concept of a long-term ECG recorder suited for an outpatient investigation up to 30 days. The device records ECG signals from a catheter placed into the esophagus in close proximity to the heart. The high demand for the patient's comfort requires miniaturization and thus, a high power efficiency of the microelectronics to capture, process and store data generated during the investigation.

The aim of this thesis was the realization of a low-power integrated voltage reference for a novel asynchronous analogue to digital converter (ADC) and the development of circuit concepts for a signal conversion to drive the ADC.

Method

The development of the voltage reference was accompanied by a study of reported integrated voltage references as well as fundamental models and concepts used in the design of low-power analogue integrated circuits. During the work, two similar voltage reference designs have been developed, simulated and integrated on an application-specific integrated circuit (ASIC) to verify the simulation results and to demonstrate the feasibility of the circuits. The conceptual

studies done on the driving circuit for the ADC implied the compilation and formulation of the design requirements to identify problems and possible solutions. High attention has been paid to a special type of analogue filters to perform a signal reconstruction from the preceding filtering blocks.

Results and Discussion

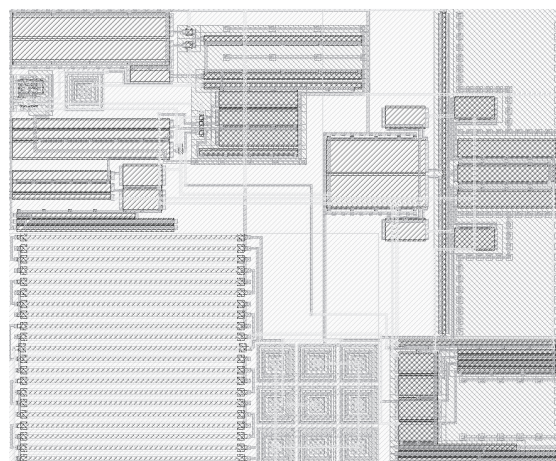
The voltage reference designs developed during the thesis operate with a power consumption of less than $10\mu\text{W}$ with a high immunity against power supply noise, process- and temperature variations. The simulated performance ratings (especially for the second design) are comparable to other reported voltage references and an appropriate output interface for the interconnection with the asynchronous ADC is given. During the work on the driving circuit of the ADC, problems and possible solutions of the demanding interface between signal preconditioning filters and the ADC were evaluated and discussed. The filtering technique studied in this context was found to be suited for continuous time analogue filtering of low amplitude biomedical signals.



Michael Nydegger



Concept of the esophageal ECG recorder E2corder



Layout view of the second voltage reference design
(Physical size: $147\mu\text{m} \times 116\mu\text{m}$)