

Preface

Digital integrated circuits have increased in importance and use in computational and signal processing fields. Since the world has an analog nature, data converters are needed to interface it to the digital processing core. To keep up with the rising speed of the digital circuits, data converters need to increase in speed and accuracy. Oversampling converters, which work at a sampling frequency many times higher than the Nyquist rate, are able to achieve the required high resolutions, at reasonably high speeds. These converters use a considerable amount of digital circuitry, which is getting cheaper, increasing their popularity in many applications.

The objective of the project described in this book is the design of a Sigma Delta Modulator ($\Sigma\Delta M$), an oversampling converter, for portable audio applications. This means both its circuit area and power dissipation must be minimized. The target bandwidth of the modulator is 20 kHz, meaning it is useful for audio applications, such as hearing aids. This also means it needs high resolution, a SNDR higher than 90 dB. The modulator uses passive integrators based on the ultra incomplete settling (UIS) concept, employing a switched-capacitor topology, eliminating the need of a high gain amplifier. Through high level models, three modulators were designed and optimized: a second order $\Sigma\Delta M$ and two versions of a third order MASH $\Sigma\Delta M$, one using a monostable circuit to reduce the size of the components.

Electrical simulations show that the second order $\Sigma\Delta M$ achieves a peak SNDR of 81.84 dB, a FOM_W of 115 fJ/conv-step, and a FOM_S of 168 dB, while dissipating 46.5 μW . The third order MASH $\Sigma\Delta M$ achieved a peak SNDR of 92.72 dB, a FOM_W of 96 fJ/conv-step, and a FOM_S of 174 dB, while dissipating 137.4 μW . The second version of the third order MASH $\Sigma\Delta M$, using the monostable circuit, achieved a peak SNDR of 92.06 dB, a FOM_W of 65.6 fJ/conv-step, and a FOM_S of 176 dB, while dissipating 85.97 μW .

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Modulators for Audio Applications

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