Preface

With this book, I want to share the experiences which I gained during my long professional work on analog-to-digital converters (ADCs) based on successive approximation (SAR ADCs) and delta-sigma architectures (ΔΣ ADC). I had the luck to start my career at Burr-Brown, which was a specialized company for highest performance analog integrated circuits such as linear products and data converters. Our team concentrated on improving the performance of ADCs, in successive steps, in terms of accuracy, speed, and power consumption, which for me was a lot of fun as the products were getting better and better. I was able to continue my research studies on ADCs even after Burr-Brown merged with Texas Instruments in 2001 and after I joined eesy-ic in 2012. In particular, the invention of the dynamic error correction (DEC) for ADCs, based on successive approximation, opened the door for all kinds of algorithms that made the design of SAR ADCs particularly interesting. Later, new semiconductor processes with dual-gate oxides enabled further new and exciting ideas and achievements.

In 2007, I started teaching students about the topic of ADCs at the University of Erlangen (Germany) and, in between, also at the University of Klagenfurt (Austria). Teaching and coaching young talents is another area that provides me a lot of fun. Therefore, this book should engage students and engineers, who are new to the topic of ADCs, with explanations of the basic parameters and architectures of ADCs in Chap. 1. I tried to illustrate and explain the topics in a way that is easy to understand. The book then continues with state-of-the-art design methodologies for SAR ADCs in Chap. 2 and for ΔΣ ADCs in Chap. 4. Here design details and schematic examples are given, which should be useful for engineers starting with the design of ADCs and for experienced IC design engineers as well. These chapters further supply background information for development engineers of the end products that include ADCs in their application. Here, the circuits that generate the load on the analog input and the reference and the distortion on the power supply are particularly important. These topics are therefore again covered in Chap. 6. Prior to that, Chaps. 3 and 5 make an excursion into current research topics on SAR ADCs and, respectively, on ΔΣ ADCs. For SAR ADCs, Chap. 3 treats the dynamic error correction and introduces new algorithms using DEC that

could achieve new levels in performance. The topic of continuous-time ΔΣ ADCs is chosen for Chap. 5.

During my work on ADCs, I also learned to appreciate the topics of verification and characterization, production test, and quality control. I spent many late hours on the test floor and in the lab to achieve yet another dB in SNR or THD performance or another fraction of an LSB in integral or differential nonlinearity. Actually, I gained the most valuable experience during the debugging of prototypes and test solutions. The full performance of an ADC can only be achieved and measured when the complete environment is optimized for it. Measuring accurately and reliably in the minimum time in mass production is particularly difficult. Young engineers should therefore consider, in particular, a career in the field of production test development. This book provides an introduction to this topic in Chap. 6.

During my work on ADCs, I was often confronted with auxiliary circuitry such as a voltage source to program the trigger level of window comparators that is using digital-to-analog converters (DACs), so Chap. 7 offers a helpful introduction to DACs and particularly explains the different architectures and the performance they are able to achieve. While detailed insights are given, however, with respect to my colleagues working on the design of DACs in general, this book does not claim to be a compendium on highest performance DAC design.

Finally, I want to thank all current and former colleagues and friends for the many interesting years developing ADCs, for the discussions we had, and for the joint developments we made. I am still getting excited if an interesting ADC project crosses my desk. Unfortunately, there are too many people to thank for me to name them individually; however, I want to list them at least as teams. First of all, I want to mention my team at eesy-ic, who still has to deal with me, including many team members, who already had to work together with me at Texas Instruments in Erlangen. I also particularly want to thank my former colleagues and friends at Texas Instruments in Erlangen (Germany), Tucson (Arizona, USA), and Bangalore (India). My special thanks however goes to my family, who had to suffer my absence during the many hours of my spare time that I spent writing this book.

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