Preface

This book describes circuit engineering efforts for modern mobile communication. Electronic circuits for latest mass applications like mobile phones and smart phones are realized as so-called systems on chip (SoC). Such SoCs are realized in nanometer CMOS technology and contain a lot of digital circuits for digital signal processing but they also contain analog circuits which often form the key devices for a good over-all performance. The importance of analog filters nowadays is often underestimated. They are, however, still necessary to obtain high-performance wireless receivers and transmitters.

In fact, progress in CMOS technology and circuit design allows the revolution in modern mobile communication. Every ten years, a new mobile phone generation is introduced. Recently, LTE (Long Term Evolution) was started by telecom companies to form the 4th generation of mobile phones. Up to 100 Mbit/s are possible with LTE for downloads, which is a much higher data rate than with HSPA+.

In the 1990s, GSM allowed mobile phone calls and SMS. Around the year 2000, the mobile phones became capable of using the internet although requiring a lot of patience. Today, mobile internet on the smart phone and via data sticks is part of the daily life. Currently a smart phone boom happens. Mobile broadband access is expected to grow by a factor of more than 20 until 2015. This will involve data rates that cannot be handled by UMTS and HSPA+. The current answer to this challenge is LTE as a standard for mobile communication. In practice, faster transmission of electronic mails with large attachments, fast downloads of music (one song in 2 seconds) and HD videos (in less than 30 minutes), web-video conferences, and online gaming (with response times below 20 ms) will become possible.

To make all this possible for a mass market, analog circuit design in nanometer CMOS technology is a very important key factor. This book concentrates on one sub-topic of analog circuit design, i.e. on analog filters. Starting from the basics of analog filters and the poor transistor characteristics in nanometer CMOS, 10 high-performance analog filters developed by the authors in 120 nm and 65 nm CMOS are described extensively. Among them are g_m-C filters, current-mode filters, and active filters for system-on-chip realization for Bluetooth, WCDMA, UWB, DVB-H, and LTE applications. For the active filters several operational amplifier designs are de-

scribed. The book, furthermore, contains a review of the newest state of research on low-voltage low-power analog filters. To cover the topic of the book comprehensively, linearization issues and measurement methods for the characterization of advanced analog filters are introduced in addition.

This book introduces newest results of development of analog filters in nanometer CMOS and describes methods how to deal successfully with the nanometer hell of physics. Numerous detailed circuit diagrams and plots of measured results allow a fast comprehension.

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Vienna, Austria

Heimo Uhrmann
Robert Kolm
Horst Zimmermann

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