

Preface

Receivers have been a basic block in telecommunication systems since the invention of the radio in the late 19th century, acquiring an essential role in what has been called the third Communication Revolution where information is transferred via controlled waves and electronic signals. Their main function is to recover the information from the transmitted wave and convert it to electronic signals that can be understood by the succeeding electronic processing signal systems. Since the Internet revolution, new receivers appeared to connect computers one to another or to the World Wide Web, such as wireless systems, have been gaining more and more popularity over the last few years. Thus, great investments in time, effort and money from both academia and industry have been made in the development of these receivers in order to achieve fully integrated solutions in form of ASICs meeting the demand for ever increasing high performance with low cost, low voltage supply, low power consumption and reduced surface area.

The design of one of these receivers include different blocks such as filters, low noise amplifiers, gain controlled amplifiers, mixers and analog to digital converters. This book is precisely focused on the analysis and design of automatic gain control, AGC, circuits with wireless receivers as the main target application. In this context, the general function of the AGC circuitry is to automatically adjust the output signal of a variable gain amplifier to an optimal rated level, for different input signal strengths. This function is essential to guarantee that the system dynamic range is neither saturated with large signals nor makes the system fall below a tolerable noise level.

Specifically, some wireless applications, such as WLAN or Bluetooth, must be able to handle packets-based data transmission and orthogonal frequency division multiplexing which introduce stringent settling-time constraints. Thus, fast AGCs are primordial in those systems. It is under these conditions that feedforward AGCs present their greatest advantages as an alternative to conventional feedback AGCs. Thus, all through this book we offer a detailed study about feedforward AGCs design—both at basic AGC cells and system level—, their main characteristics and performances.

The starting point is a complete review and theoretical analysis of both feedforward and feedback configurations and their behavioural modelling, issues addressed in Chap. 2.

Next, basic components in gain control function, i.e., variable/programmable gain amplifiers, peak detectors and control voltage generation circuits are examined. These basic blocks must be carefully chosen as they will limit the full AGC performance, so their specifications have to guarantee those required by the corresponding application. Thus, the main challenges and solutions encountered during the design of such high performance cells are summarized in Chap. 3 and different high performance integrated proposals that will be next employed in specific AGCs are described and characterized considering low voltage low power constraints. To achieve low power consumption and ease any future scale to shorter transistor channel length technologies, low voltage power supplies have been employed: this requires greater effort in the design, but guarantees the validity of the achieved results in current submicron process technologies.

To close, the work is focused on the complete characterization of few different gain control loops required to implement a complete AGC system making use of some previously studied cells. Three complete AGC proposals are fully designed and evaluated in Chap. 4: a general purpose digital feedforward CMOS AGC operating at 100 MHz, a fully analogue feedforward AGC for an 802.11a WLAN receiver in SiGe BiCMOS technology and a combined feedforward/feedback CMOS AGC for operating frequencies up to 250 MHz. These novel AGC contributions, more than competitive with those already presented in the literature, prove that feedforward AGCs are a fine alternative in wireless receiver applications, evidencing that this class of circuits will take an important role in upcoming applications where the stringent time constraints preclude the use of conventional closed-loop AGCs.



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