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Numerical Study of Structural Variants of Bipolar Magnetotransistors

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We present a review of numerical simulations of the operation and the performance of various dual-collector magnetotransistor structures differing in design and fabrication process. For each structural variant, we analyze the trade-off between high magnetic sensitivity and efficient suppression of parasitic effects causing noise and unnecessary power consumption. As a result of our study, we suggest two unconventional device modifications (micromachined or silicon-on-insulator (SOI)-based structures) as especially promising solutions to the optimization problem.

1. Introduction

Since their first appearance in the early 1950's magnetotransistors have found a growing range of industrial applications. Typical examples are encountered in automotive systems, process control, automation and robotics. Silicon magetotransistors fabricated by standard integrated circuit (IC) technology[1-3] allow the monolithic cointegration of the sensor element with other semiconductor devices on the same chip and thereby enable on-chip combination with the electronics required for biasing, signal amplification and filtering, error compensation and self-testing.[4] Besides the circuit aspects, magnetotransistors have indisputable advantages such as a linear output signal,[5] high magnetic field sensitivity,[6,7] high spatial resolution (as a consequence of the small overall size), noise filtering,[8,9] offset correction,[10] and the detection of magnitude and direction of the magnetic field by a crosswise arrangement of several sensor units.[11,12]

In this article we present two-dimensional simulations of some recently proposed new