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Bipolar Magnetotransistors and Their Trade-Offs

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High relative sensitivity, $\Delta I_C/[I_C(0)B]$, in dual-collector magnetotransistors with suppressed sidewall injection (SSIMT) is obtained at the expense of current gain and, hence, with high power consumption. This is due to large base width, which is on the order of the minority carrier diffusion length; reduced emitter efficiency; and a substrate which acts as an additional collector for a vertical transistor. For minimal offset, low temperature coefficient (TC) and optimal noise behavior, operation of the devices with low power consumption is highly desirable. In this paper we review the different options for improved electrical performance of SSIMT's. We find that better electrical performance of the devices is obtained at the expense of magnetic sensitivity. However, in view of cointegrating dual-collector magnetotransistors with biasing and signal conditioning circuits on the same chip, a compromise between the electrical performance and relative sensitivity of the devices seems possible.

1. Introduction

Bipolar dual-collector magnetotransistors (MT's) are candidates for many different industrial large-scale applications requiring inexpensive, batch-fabricated magnetic sensors. Moreover, they have been proposed for multidirectional magnetometry in magnetic vector probes,[1] in view of their field direction sensing capability. A magnetic field parallel or perpendicular to the chip plane can be detected depending on the chosen device geometry.

MT's are compatible with different industrial integrated circuit (IC) technologies such as bipolar, CMOS and BiCMOS processes. Therefore, the sensor element can