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# Galvanomagnetic Transport in P-N Junctions

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Results of high resolution ( $\pm$ 0.5 $\mu$V) numerical modeling of the emitter-base junction in magnetotransistors (MT) are presented. It is shown that the Hall voltage along the junction is virtually zero ($<1\,\mu$V) at low injection and extremely small ($\sim 50\,\mu$V/T) at high injection, whereas magnetoconcentration ($\sim 1\%$/T) occurs at high injection. This seems to rule out "emitter injection modulation" as an operating principle in MT's.

## 1. Introduction

Intuitive physical models of magnetotransistor (MT) operation, while valuable heuristic tools, appear unable to explain the complex interaction of bipolar action and the Lorentz force. But the correct representation of the MT's internal behavior (electric potential, current, and carrier density distributions) can be obtained by solving the carrier transport equations under pertinent boundary conditions.[1]

One established intuitive model for MT operation is "emitter injection modulation" and is believed to be caused by an "intrinsic" Hall voltage $V_H(B)$ along the emitter-base junction due to the action of the Lorentz force on the injected carriers.[2] This supposedly leads to a modulation of the emitter base voltage, $V_{BE} \pm V_H(B)$ and consequently, to a modulation of the collector current, $I_C(B) \sim \exp[V_{BE} \pm V_H(B)]$, for recent single or multiple collector lateral MT's.[3-5] We tried to verify this effect by measuring the voltage along the junction of the recently devised suppressed sidewall injection magnetotransistor (SSIMT). The $p^+$ stripes (normally used to suppress lateral injection[6]) were biased with constant current sources, $I_{B1} = I_{B2} = I_E/2$ to forward bias the emitter-base junction (see Fig. 1). The differential