Planar Hall effect in the Vertical Hall Sensor

Part II - Revised interpretation

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Summary

Due to the symmetrical structure of the Vertical Hall Sensor (VHS) there existed reasonable doubts, whether a magnetic field in the VHS plane will at all generate a "planar" Hall voltage. Therefore, the first investigations in the above matter, carried out a few years ago, were mainly an attempt to find an answer to the mentioned question, meanwhile the resulting equation (based on a mathematical model for the current distribution within the VHS) did not pretend to be numerically exact .

Meanwhile, detailed measurements of the VHS "planar" Hall volt- age, performed recently, brought up some differences between the experimental and theoretical results. Although the main discrepancy concerned a $\pi/2$-shift between the sinusoidal dependencies of the "planar" Hall voltage, the numerical values of the amplitudes of the latter one did not agree to well either.

Because there were no doubts about the correctness of the mea- surements, it became obviously necessary to check the previous theoretical solution for the "planar" Hall voltage. During the examination it was discovered - apart from some minor miscalculations and careless slips - an error in the formula for the angle between the curved current path and the magnetic field direction, which was responsible for the above mentioned discrepancy. Therefore, the aim of the present revised interpretation was to show that it is possible to achieve even with simple mathematical models theoretical solution for the strength of the "planar" Hall voltage, being now fully compatible with the experimental results.

Finally, it was proved that a combination of 2 VHS's, facing the normal magnetic field in opposite directions and whose Hall electrodes were connected to a differential amplifier, will show in an inhomogenous magnetic field at all times no "planar" Hall voltage at the amplifier output.