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AN INTEGRATED CONTINUOUS OUTPUT LINEAR POWER SENSOR USING HALL EFFECT VECTOR MULTIPLICATION

by

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ABSTRACT

Keywords: Hall generator, Hall sensor, Hall voltage, Hall multiplication, Hall effect sensor, magnetic field sensor, magnetoresistance, magnetoconcentration, galvanomagnetic effects, thermomagnetic effects, thermoelectric effects, piezoresistive effects, quadrature rotation, multifinger transistors, chip on board.

A Hall generator inherently functions as a multiplier in that it yields a Hall voltage representing the cross product of the bias current vector and the perpendicular magnetic field vector. These properties can be exploited in power source systems to sense supply voltage and current and directly yield the product and thus power consumption in real-time applications. As a result, no multiplication circuitry is required. The active area and manufacturing costs are thus reduced when used within integrated circuits (IC).

This document describes the design of a linear power sensor based on Hall multiplication. The primary design goal was to design a functional linear power sensor using less circuitry and thus decreasing costs when compared to conventional methods used for power metering applications. The sensor is thus intended for integration into currently available single-chip power meter solutions through minor modification.

The sub-circuits necessary for a fully functional system has been designed and simulated. These include; i) voltage to current converters for biasing the Hall generator as a function of the source voltage, ii) bandgap reference for temperature independent on-chip referencing, iii) operational amplifiers for sensing and amplification of the Hall voltage and, iv) offset cancellation circuitry for removing offsets inherent in the amplifiers as well as the Hall generator.

The sensor has been verified on system level through both simulation and discrete component level testing.

UITTREKSEL

Sleutelwoorde: Hall-opwekker, Hall-sensor, Hall-spanning, Hall-vermenigvuldiging, Hall-effek sensor, magneetveld sensor, magnetoweerstand, magnetokonsentrasie, galvanomagnetiese effekte, termomagnetiese effekte, termoelektriese effekte, piezoweerstand effekte, kwadratuur rotasie, multivinger transistors, vlokkie-op-bord.

'n Hall-opwekker kan soos 'n vermenigvuldiger funksioneer wat 'n Hall spanning lewer. Dit kan die kruisproduk van die voorstroom vektor en loodregte magneetveld vektor voorstel. Dié eienskappe kan gebruik word in kragbronne om toevoerspanning en -stroom te meet en direk 'n produk te lewer, wat drywingsverbruik intyds voorstel. Dus word vermenigvuldiging stroombane nie benodig nie. Die aktiewe area benodig word verminder wanneer dit toegepas word in geïntegreerde stroombane, en so word vervaardigingskostes verminder.

Hierdie dokument beskryf die ontwerp van 'n liniêre drywingsensor wat op Hall-vermenigvuldiging gebasseer is. Die primêre ontwerpsdoel was om 'n funksionele liniêre drywingsensor te ontwerp, wat minder stroombane benodig om kostes te verminder wanneer vergelyk word met huidige drywingsmeting toepassings. Die sensor is ontwerp met huidige enkelvlokkie drywingsmeters in gedagte en sal slegs klein veranderings benodig om by ander stelsels aan te pas.

Die boublokke wat benodig word vir 'n volledige, werkende stelsel is ontwerp en gesimuleer. Hierdie sluit in: i) 'n spanning-na-stroom omsetter, vir voorspanning van die Hall-opwekker, wat eweredig is aan die kragbron spanning, ii) 'n bandgaping verwysing vir temperatuur onafhanklikke spanningsverwysing, wat benodig word deur verskeie stroombane, iii) operasionele versterkers, om die Hall-spanning te meet en te versterk en, iv) afset kansellasie stroombane, om wanbalanse te verwyder wat inherent voorkom in versterkers sowel as die Hall-opwekker.

Die sensor is op stelselvlak sowel as op diskrete komponent vlak gesimuleer en funksioneer korrek.

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