Hall Effect Design Outline and Checklist

1. Start the “generic” design by selecting appropriate type of Hall sensor
    - Switch – digital output
    - Latch – digital output requires alternating poles
    - Linear sensor – analog output proportional to B
    - Power – high current latching device
    - Programmable – switching or linear with adjustable properties
2. Review sensors of desired type and select a “starting” point
3. Determine preliminary magnetic requirements
    - Pole configuration
    - Alignment concerns
    - Restricted space limitations
    - Total Effective Air Gap (TEAG) variation
    - Initial size of magnet
4. Analyze the preliminary design
    a. Select an initial material
    b. Use magnetics software such as BEA/FEA or custom package to analyze output of nominal conditions.
    c. Analyze output of magnet with respect to Hall sensor specifications
        i. Could be linearity, Bop, Brp, Bhys, physical hysteresis
        ii. Determine if response is in acceptable range
            1. If not, then re-choose sensor or magnet material or configuration and begin the process again.
            2. Once satisfied, proceed to step 5.
5. Begin worst case analysis of design
    a. Calculate Pc for worst case permeance
    b. Use the Pc calculated along with the intrinsic demag curve to predict irreversible losses.
    c. Identify worst case scenario for the sensor systems design
    d. Analyze system for worst case scenario including irreversible losses
        i. If system fails requirements, return to factors under design control and start again.
        ii. If system passes requirements, continue on to step 6. Some designs may require comparison to best case conditions or opposite spectrum conditions for complete variation analysis.
6. Evaluate design for “critical factors” determining final design variation.
    a. System cost
    b. Minimize irreversible losses
    c. Minimize variation in magnetic performance vs. positional tolerances
7. Repeat all steps above as necessary to finalize design

Checklist

Select type of Hall effect device

☐ Switch ☐ Programmable
☐ Latch ☐ Switch
☐ Linear ☐ Linear
☐ Power

Select Hall effect device
Manufacturer:_____
Model number:_____

Determine preliminary magnetic requirements

☐ Pole config. ☐ TEAG
☐ Alignment tolerances ☐ Min
☐ Space limits ☐ Nominal
☐ Initial magnet size ☐ Max
☐ Temperature range:_____

Select material:_____

Analyze magnetic output

☐ B_{op} ☐ B_{rp}
☐ B_{hys} ☐ Physical hysteresis
☐ Linearity ☐ Saturation of Hall

Calculate worst case Pc:_____

Predict irreversible losses:_____

Determine worst case operating conditions

☐ TEAG max ☐ Temp max
☐ Max offset position ☐ LMC magnet
☐ Irreversible losses ☐ Min magnet props.

Apply safety factor to magnetics:

☐ 5% ☐ 10% ☐ 15%

Perform final analysis of design

☐ B_{op} ☐ B_{rp}
☐ B_{hys} ☐ Physical hysteresis
☐ Linearity ☐ Saturation of Hall

Optimize design for critical factors

☐ Price
☐ Irreversible Losses
☐ Variation reduction
☐ Other: _____

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