

## 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  $P_c$ : \_\_\_\_\_

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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