3-Dimensional Magnetic Mapping for Reed Sensor Accuracy

Product Training
Introduction

Purpose

- Introduce the concept of magnetic mapping and how it helps the reed sensor designer

Objectives

- Introduce magnetic mapping technology
- Define the key functions and key terms
- Define how magnetic mapping can help the Sensor designer
Defining the Reed Sensor

- The reed sensor is an ideal method of sensing and detecting movement.
- Typically a permanent magnet is the moving member in the magnetic system.
- A hermetically sealed reed switch is generally mounted to a PCB or hard wired to an electrical circuit.
- The reed switch senses the physical movement of the magnet and the reed contacts will close or open.
Key Terms

- When a reed sensor’s contacts close its called the pull-in or closure point
- When a reed sensor’s contacts open it’s called the drop-out or opening point
- Reed sensor hysteresis is defined as the ratio of the Drop-out/Pull-in
Key Terms - Hysteresis

- Understanding Hysteresis in a reed sensor is important.
- Sense points in liquid level sensing can be unstable particularly when the liquid level is in a moving vehicle.
- Under this condition with no hysteresis the closure point would continue to fluctuate as well as the opening point with any small changes in the liquid level.
Reed sensors can be selected for varying degrees of hysteresis.

A typical wide hysteresis would be about 50%.

So if the closure point is 1.0 inch (2.54 cm) away from the reference point, the drop out point would be 0.5 inches (1.27 cm).

Or Hysteresis = Dropout/Pull-in x (100%)
Key Terms

- The magnetic fields we will be talking about are generally produced by permanent magnets.
- Ferromagnetic materials are those metals that affect the flow of magnetic lines of force.
- Ferromagnetic materials are generally iron, steel, nickel, and cobalt.
Magnetic Field Mapping

- Magnetic mapping is the method of incrementally measuring the pull-in and drop-out points.
- The movement is carried out in all three dimensions.
- Software is then used to bridge all the points.
3-D Field Mapping

- Example using only one magnet and one reed sensor
- This example has the magnet in a slight vertical offset relative to the reed sensor sitting on a PCB
- The pull-in and drop-out fields are shown 3 dimensionally
3-D Field Mapping Example

- Pull-in and Drop-out fields from a frontal view

- Magnet
- Drop-out field
- Pull-in field
3-D Field Mapping Example

- Pull-in and Drop-out fields from a frontal view

- Magnet
- Drop-out field
- Pull-in field

Hysteresis
3-D Field Mapping Example

- Pull-in and Drop-out fields from a side view

- Magnet
- Drop-out field
- Pull-in field
3-D Field Mapping Example

- Pull-in and Drop-out fields from a side view

- Magnet
- Drop-out field
- Pull-in field

Hysteresis
3-D Field Mapping Example

- Displaying pull-in and drop-out mapping boundaries.
- Three dimensional viewing is critical to optimize parameters.
Mapping Results

- In the mapping example if a maximum sensing distance is required the design must change.
- If the magnet and reed sensor position can not be changed then a more sensitive reed sensor needs to be used.
- Or you will have to use a stronger magnet - usually this will add cost.
Why Magnetically Map?

- In Sensor applications it is important to understand the exact pull-in and drop-out fields.
- This information then allows one to properly position the magnet and sensor well within appropriate guard bands and avoid any tolerance issues.
- Mapping allows the designer to solidify his design before finalizing all design constraints.
Summary

- Adequate operate and deactivate points
- Operation well within the magnetic envelopes to avoid tolerance issues
- Acceptable hysteresis between the operate and deactivate points
- Sensor and magnet costs optimized
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