3-Dimensional Magnetic Mapping for Reed Sensor Accuracy

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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 it's 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

Key Terms - Hysteresis

- 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.

3-D Magnetic field mapping

Application example and why it's important

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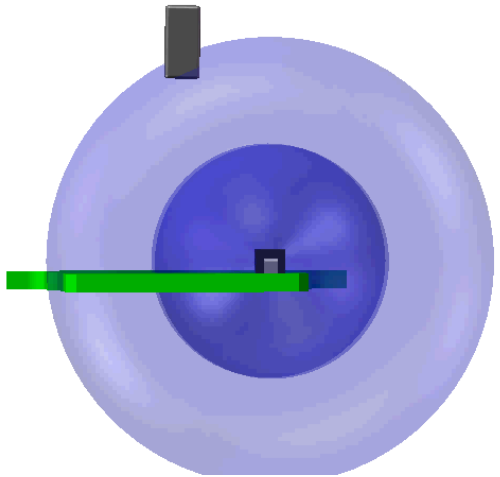
Magnetic Field Mapping

- 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

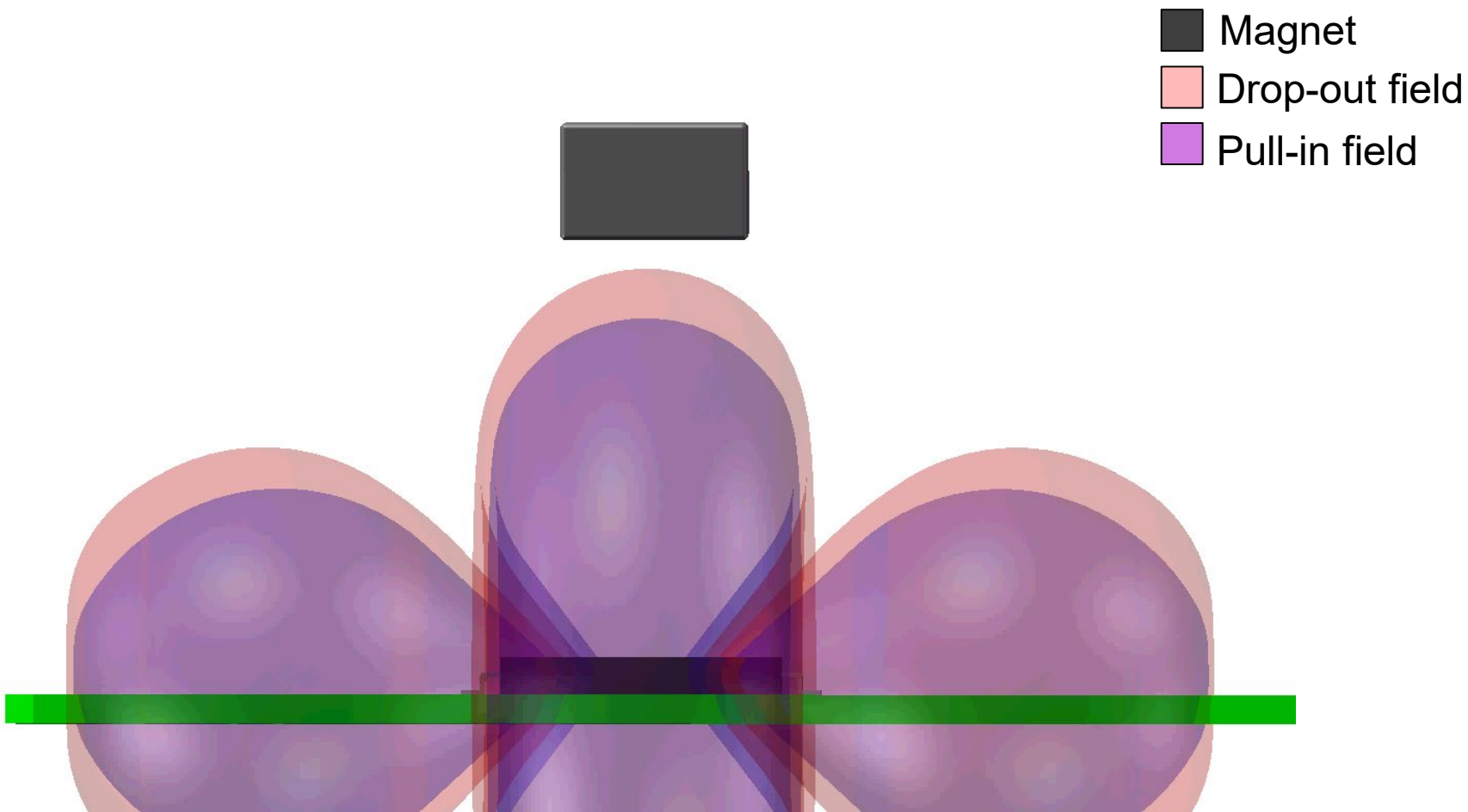
3-D Field Mapping

- 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



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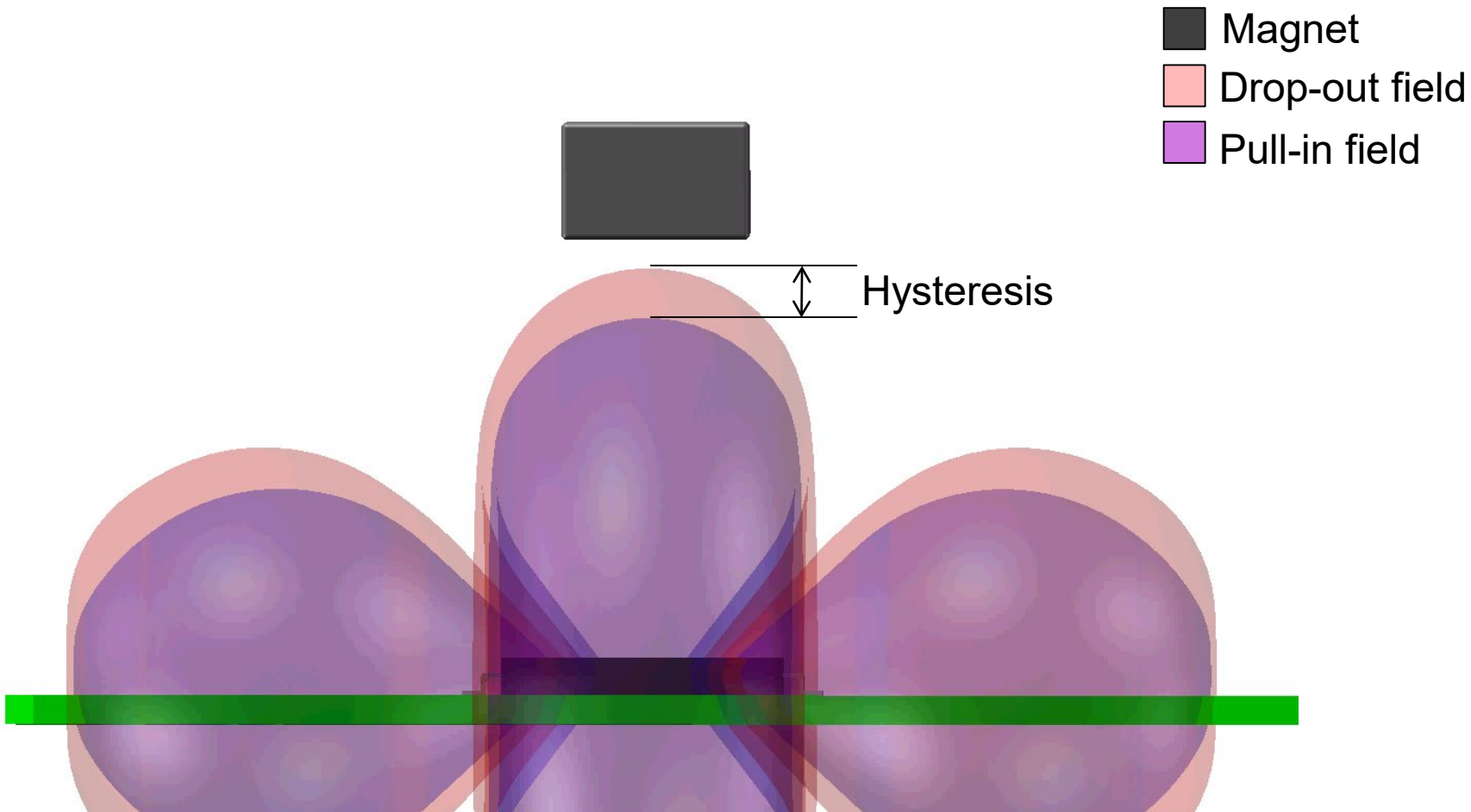
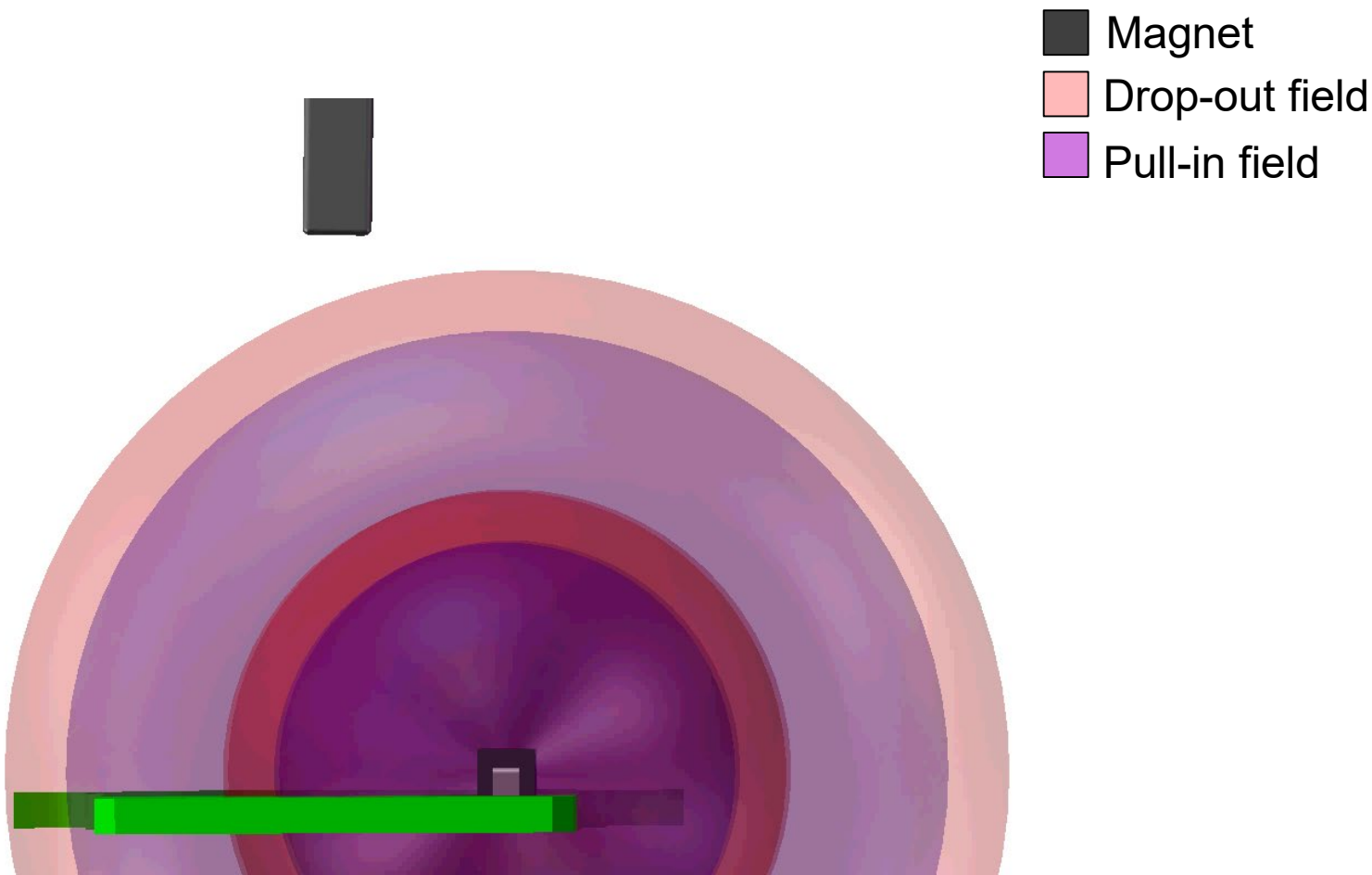


3-D Field Mapping Example

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



3-D Field Mapping Example

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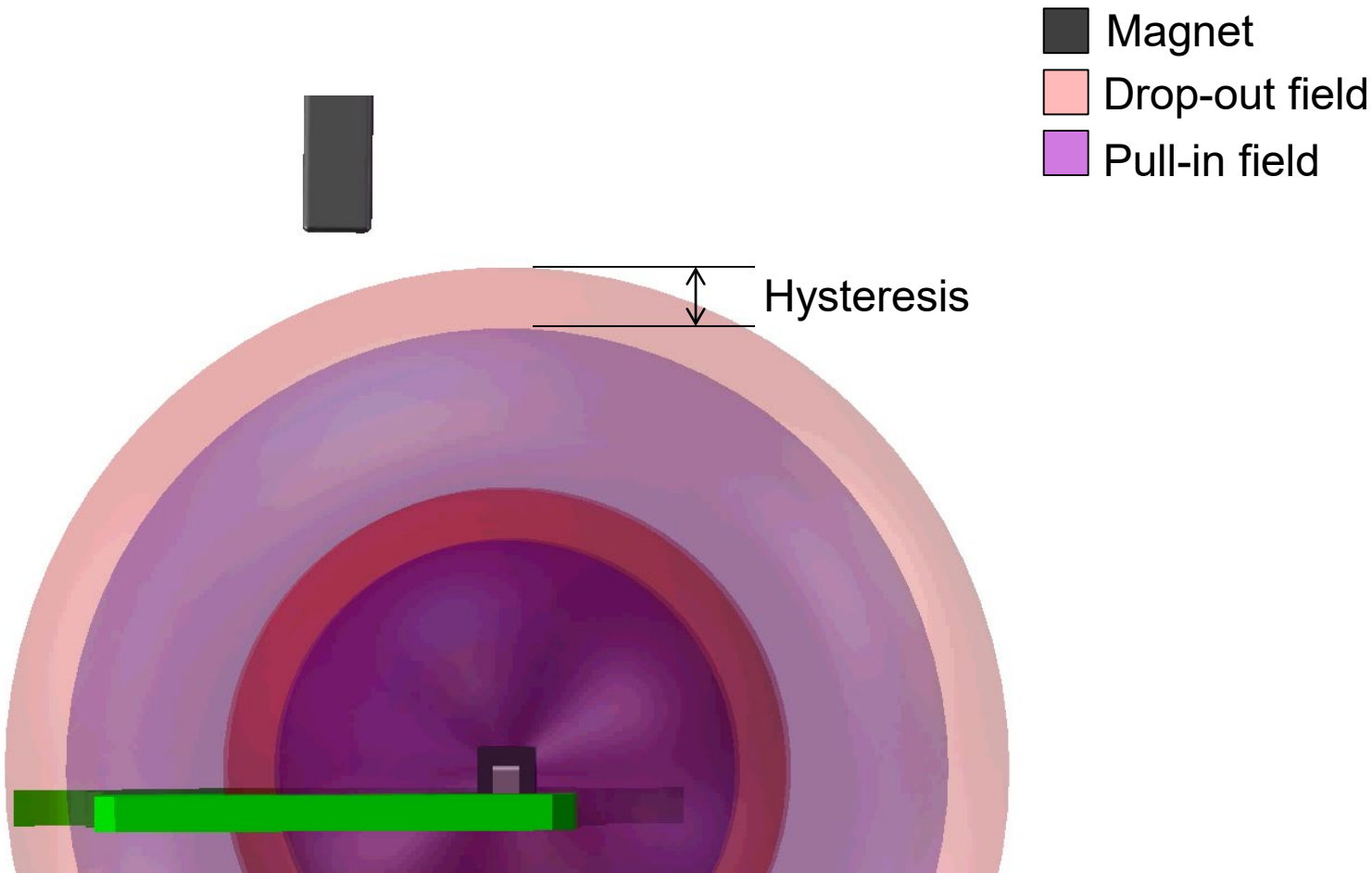
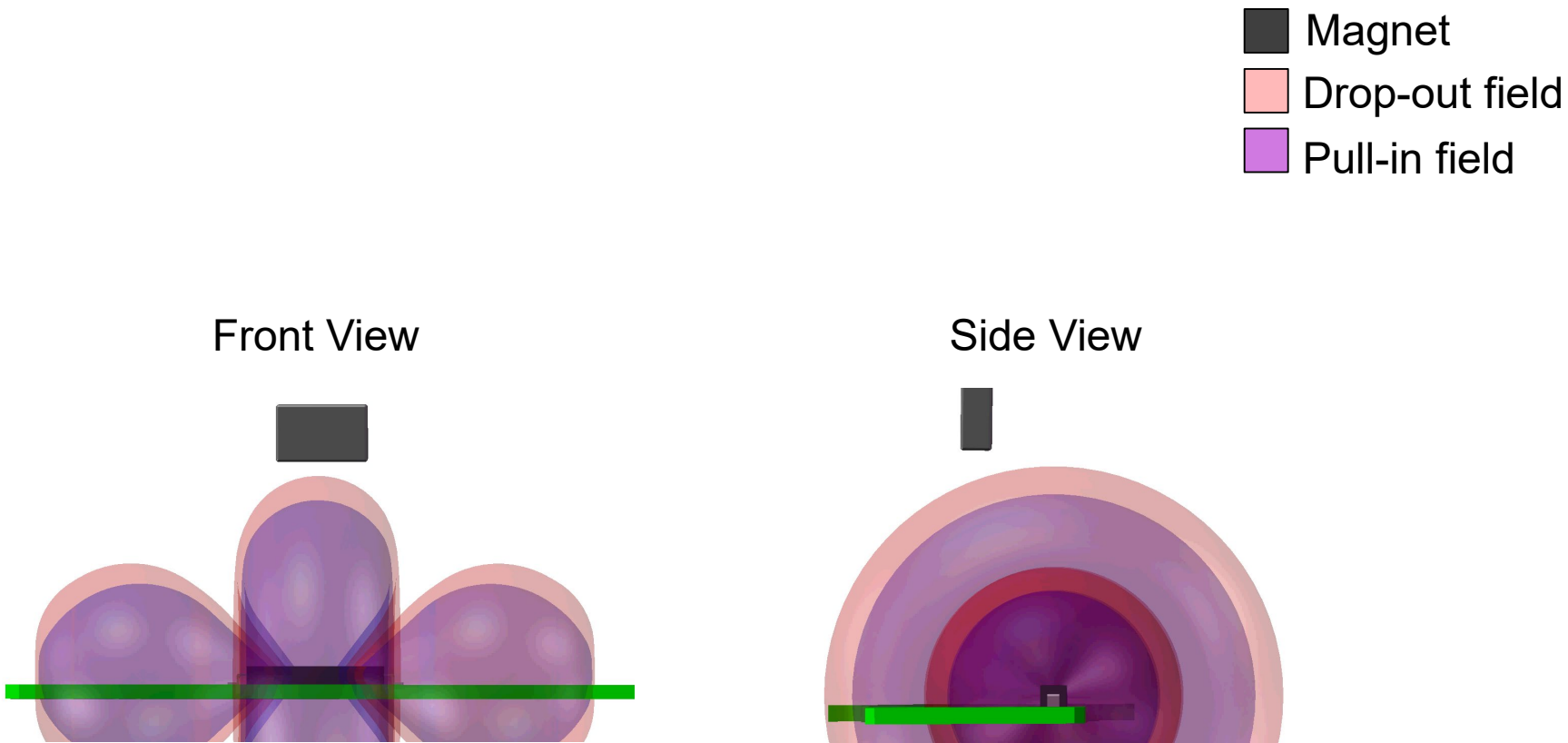


3-D Field Mapping Example

- 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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