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Reed Switch & Magnet Interaction

Product Training

Introduction

Purpose

☐ Explore the technology of how magnets interact with reed switches producing a reed sensor

Objectives

☐ Define key terms of magnets and reed switches

☐ Describe the different positions of the magnet relative to the reed switch and its effects in two dimensions and three dimensions

☐ Describe the sensing function

Key Terms

Permanent Magnet

- Steady magnetic field

- Has a north and south pole

- Available in various sizes

- Available in different strengths

- Magnetic strength is measured in gauss or milliTesla

- Magnets come in different materials – rare earth, Alnico, and ferrite

- Rare earth are the strongest magnets

N   S

Permanent Magnet

# Key Terms

Reed Switch

- Two ferromagnetic leads

- Hermetically sealed in a glass cylinder

- The two reeds are separated internally forming a gap

- Sensitivity to closure is measured in milli-Tesla (mT) or ampere turns (AT)

- Come in various cylindrical sizes

- When the magnet is brought in close enough to the reed switch the contacts will close. This is called the pull-in point. (PI)

- When the magnet is removed from the proximity of the reed switch the contacts will open. This is called the drop-out point. (DO)

- Hysteresis is the ratio of the pull-in divided by the drop-out (PI/DO)
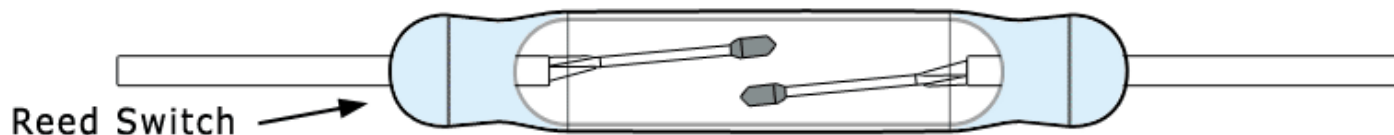
Reed Switch →

Reed Switch Sensors

- Reed switch sensors are comprised of a reed switch and a magnet.
- The reed switches are packaged in several ways depending upon the application
- The magnet is usually packaged or attached to a moveable mechanism
- Usually the magnet is brought into the sphere of influence of the reed switch closing the contacts and carrying out the sensing application.
- The key to a successful application is the proper usage of the magnet and the reed switch as they interact in this sphere of influence.
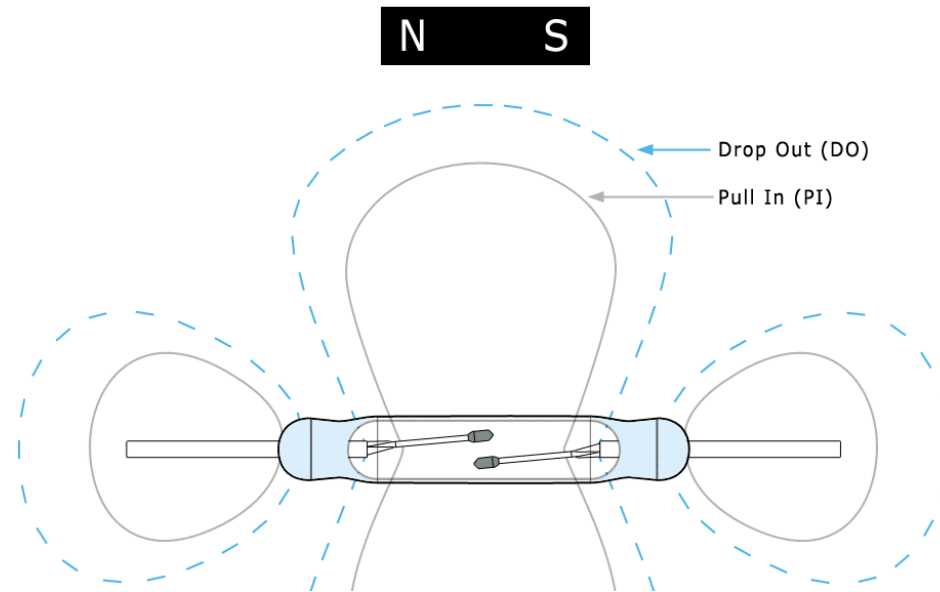
Click to Animate
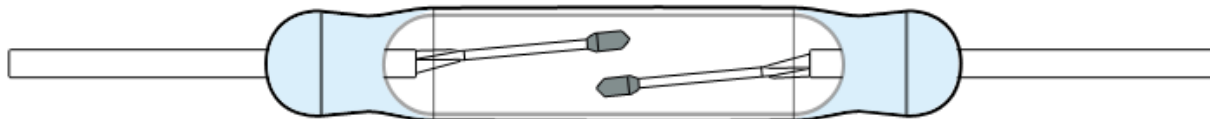
Two Dimensional Magnetic Fields
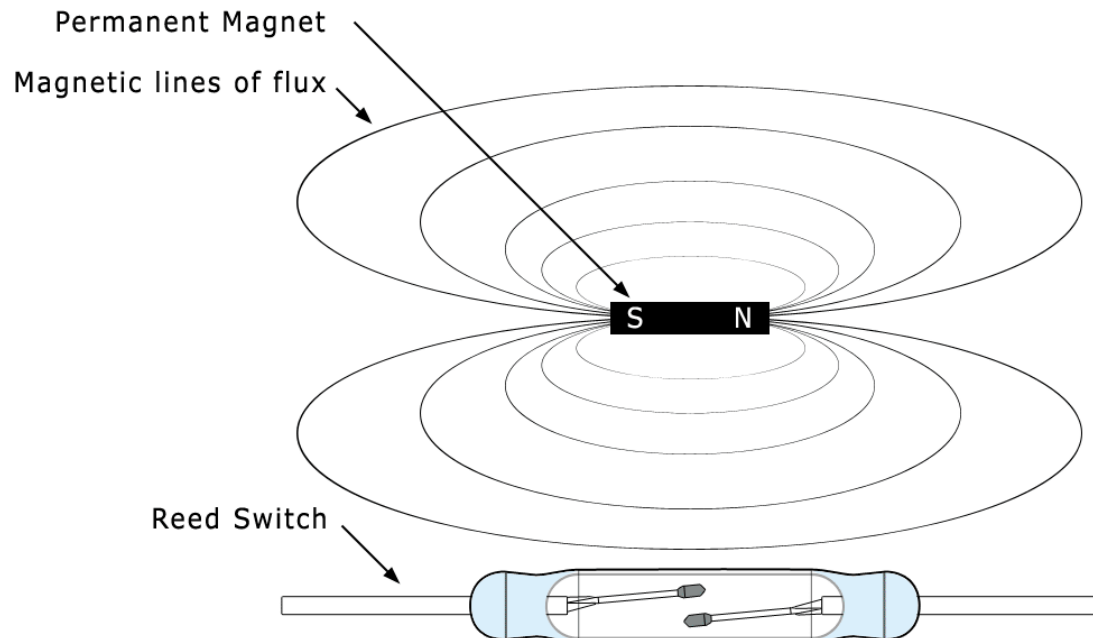
2-D Magnetic Field Arrays

Magnet Parallel to the Reed Switch and Centered

- When the magnet is parallel to the reed switch 3 lobes are generated with magnetic sensitivity arrays.

- No matter where the magnet is placed, as long as the magnet is parallel to the reed switch, the 3 lobes will be present

- The solid lines represent pull-in points (PI)

- The dotted lines show the drop-out points (DO)

- Reversing the polarity of the magnet rotating it 180° will have no effect on the generated magnetic sensitivity lobes

Magnetic Lines of Flux

- The lines of magnetic flux are shown leaving the north pole of the magnet and entering the south pole of the magnet.

- Bringing the magnet closer to the reed switch will create the interaction between the magnetic flux and the magnetic sensitivity lobes

- The two fields are superimposed upon one another creating the interaction that closes the contacts and upon withdrawal opens the contacts

Permanent Magnet

Magnetic lines of flux

S   N

Reed Switch

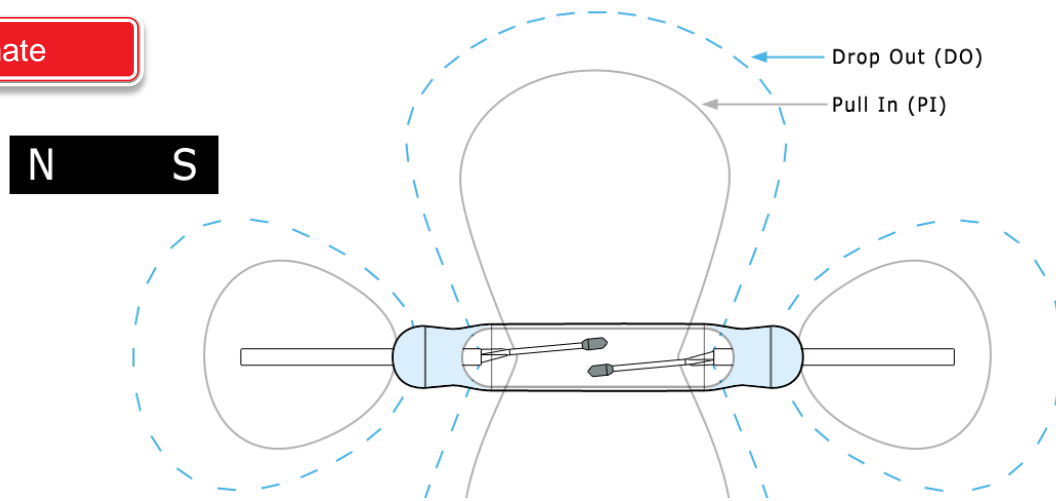# Magnet Parallel to the Reed Switch and Centered

- When the magnet is parallel to the reed switch 3 lobes are present showing the generated arrays of magnetic sensitivity.

- The magnet will move into the center lobe

- The solid lines represent pull-in points (PI)

- The dotted lines show the drop-out points (DO)

- Once the magnet crosses these lines, the contacts will change their state

N   S

Click to Animate

Drop Out (DO)

Pull In (PI)
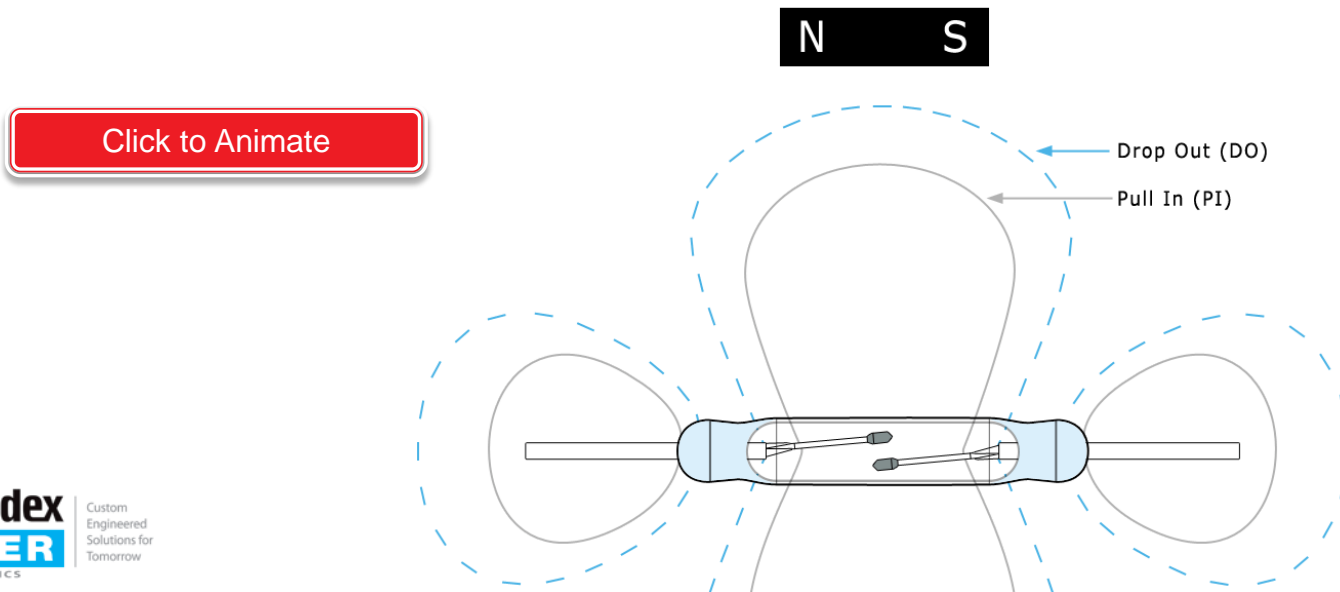
Magnet Parallel to the Reed Switch

☐ When the magnet is parallel the 3 lobes are present as below showing the generated arrays of magnetic sensitivity.

☐ In this case the magnet is coming from the side but still offset from the axis of the reed switch

☐ The solid lines represent pull-in points and dotted lines the drop-out points

☐ Once the magnet crosses these lines, the contacts will change their state
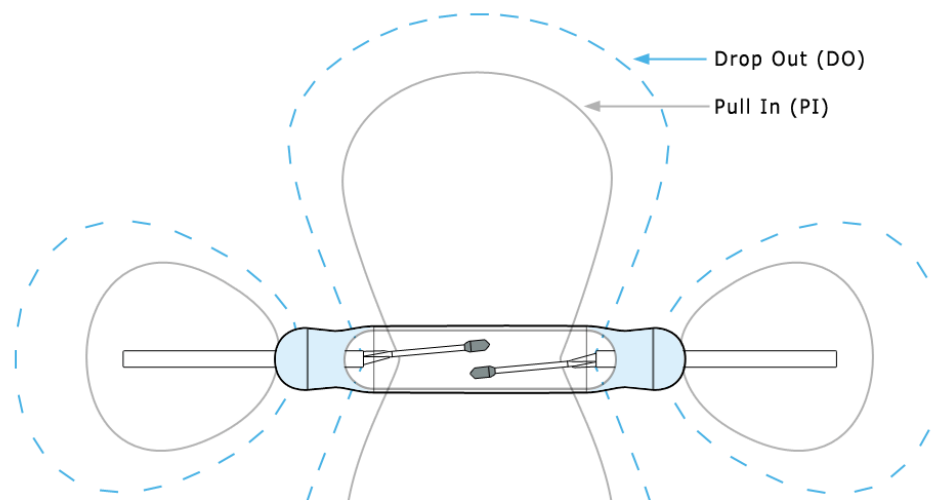
Click to Animate

N   S

Drop Out (DO)

Pull In (PI)

Magnet Parallel to the Reed Switch

☐ The magnet is parallel so the 3 lobes are still present

☐ In this case the magnet is coming from the side along the axis of the reed switch

☐ With magnet again moving left to right it will move into the first lobe on the left closing the contacts

☐ When the magnet is withdrawn, moving left, the contacts will open

Click to Animate

N S

□ reference point

Drop Out (DO)

Pull In (PI)

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Magnet Parallel to the Reed Switch

- Again the magnet is parallel to the reed switch so the 3 lobes are still present

- In this case the magnet is again coming from the side along the axis of the reed switch

- With magnet again moving left to right it will pass through to the other end of the switch

- With this approach the contacts will close and open three times
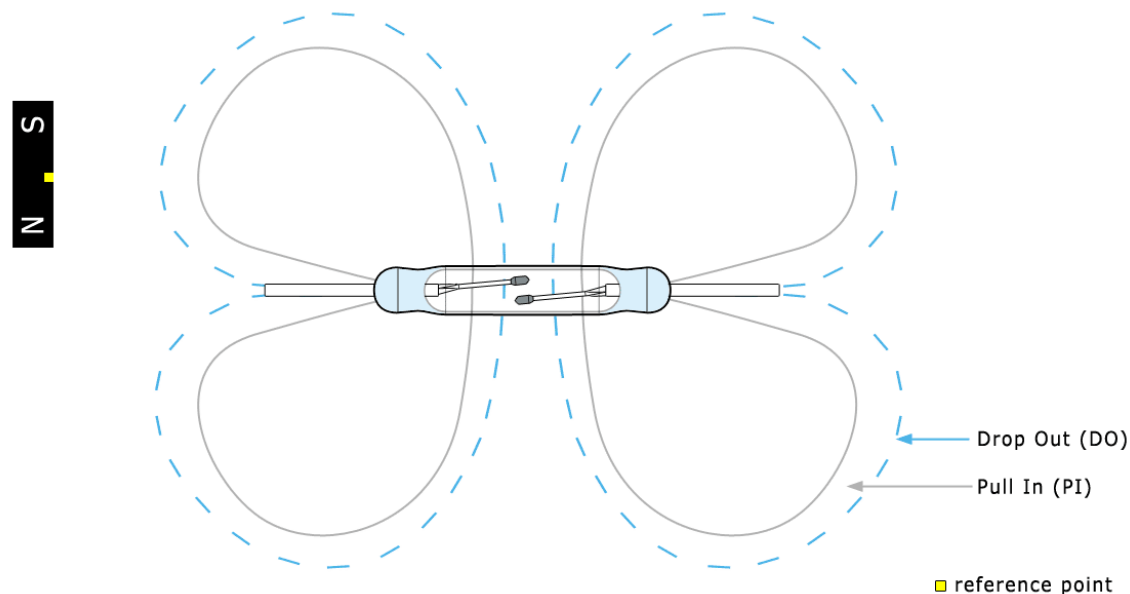
Click to Animate
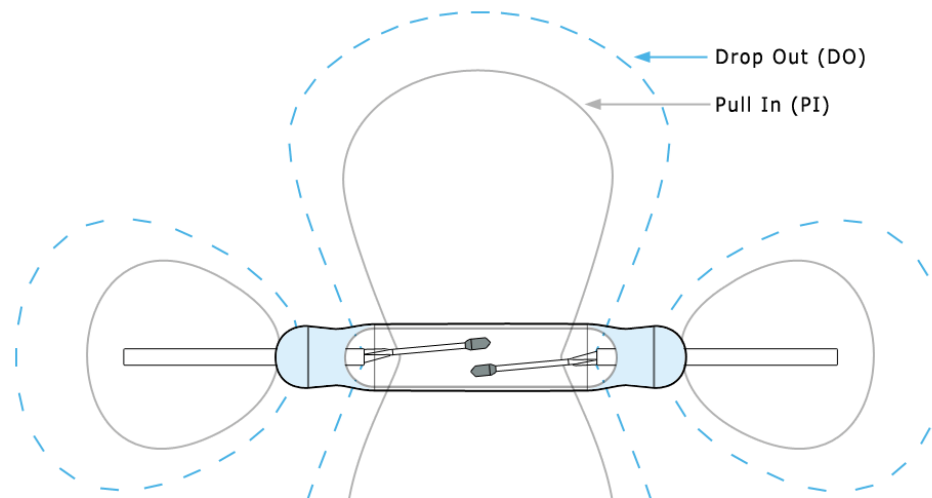
Drop Out (DO)

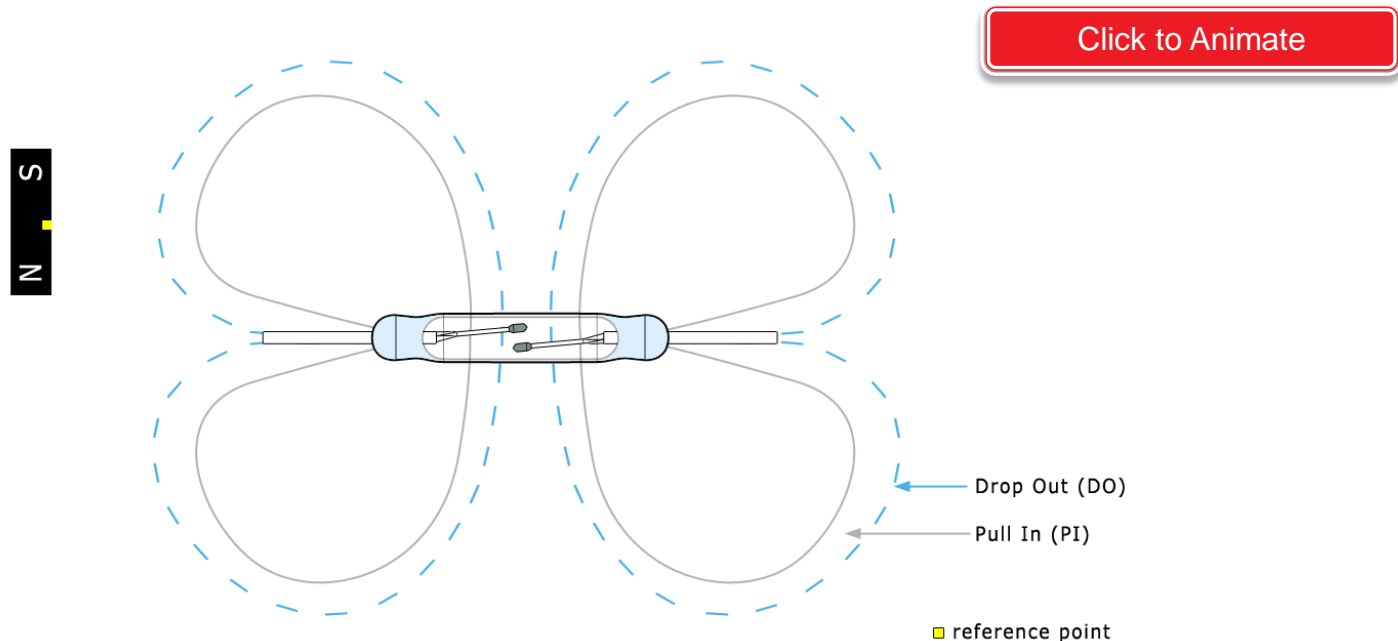Pull In (PI)

N   S

reference point

Magnet Perpendicular to the Reed Switch

- When the magnet is turned perpendicular to the reed switch the magnetic sensitivity lobes change dramatically.

- The lines of flux of the magnet remain the same always

- The magnetic sensitivity lobes are now only on the ends

- The sensitivity lobes are offset from the center of the axis of the reed switch

- Bringing the magnet into the upper left lobe and then withdrawing it will close and open the contacts

Drop Out (DO)

Pull In (PI)

□ reference point

Magnet Perpendicular to the Reed Switch

- When the magnet is turned perpendicular to the reed switch four magnetic sensitivity lobes are present.

- Bringing the magnet in offset to the axis of the switch and through to the other end of the switch the contacts will close and open two times

Click to Animate

Drop Out (DO)

Pull In (PI)

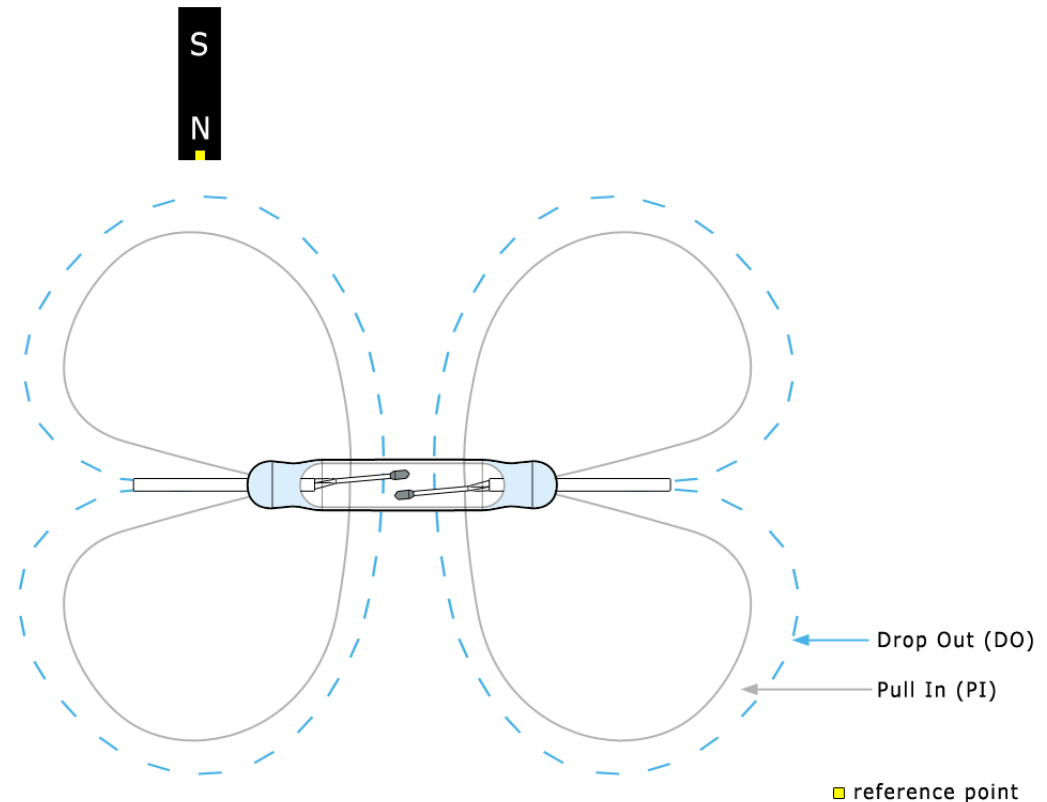reference point

Magnet Perpendicular to the Reed Switch

- Four magnetic sensitivity lobes are present when the magnet is perpendicular to the reed switch

- Bringing the magnet from left to right along the axis of the switch and through to the other end of the reed switch the contacts will never close

Click to Animate

Drop Out (DO)

Pull In (PI)

reference point
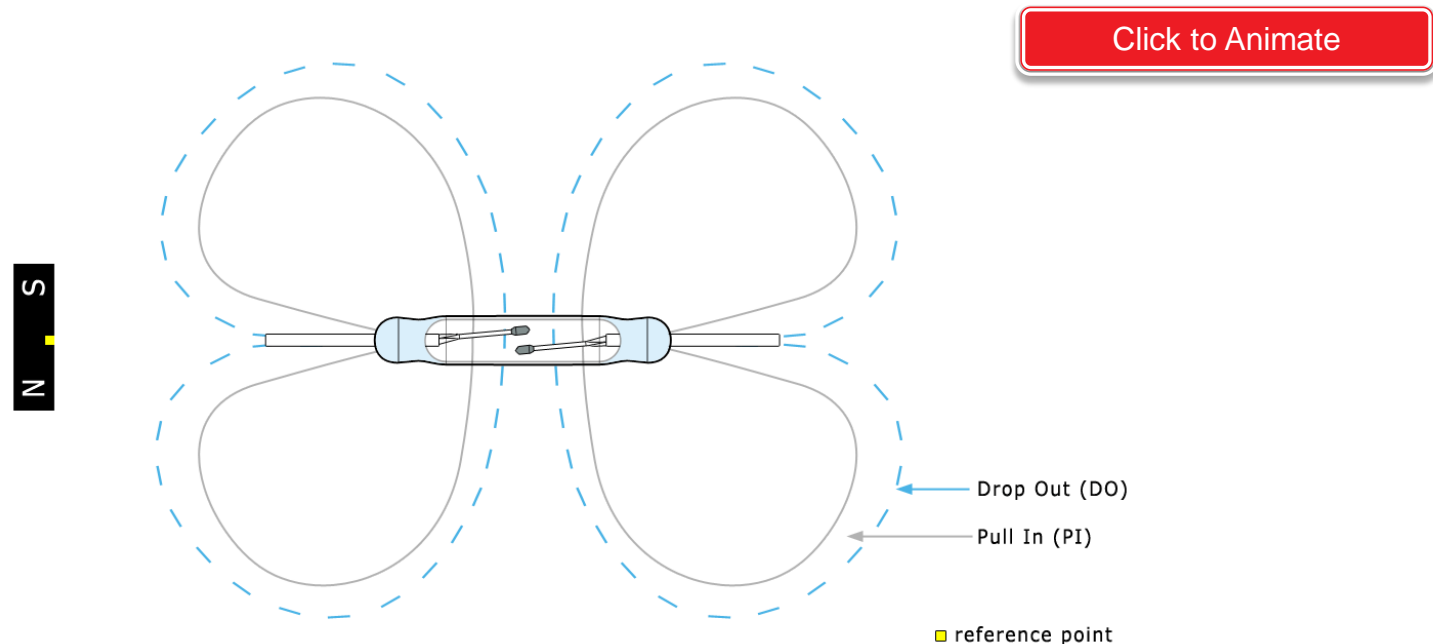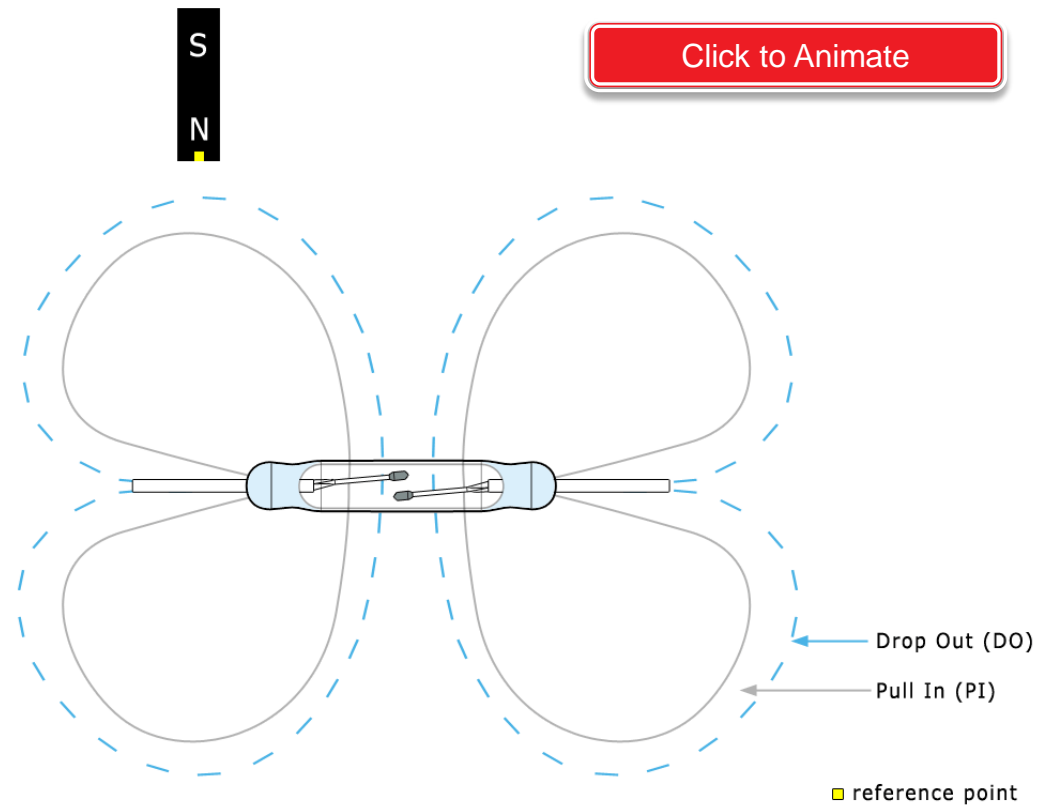
Magnet Perpendicular to the Reed Switch

- Again the magnet is perpendicular to the reed switch

- Bringing the magnet from top downward into the upper left lobe the contacts will close and then open when the magnet is withdrawn upwards

Click to Animate

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Drop Out (DO)

Pull In (PI)

reference point

Magnet Perpendicular to the Reed Switch

- Magnet is perpendicular to the reed switch

- Bringing the magnet downward into the upper left lobe of the contacts and continue through the lower left lobe.

- In this case, the contacts will close and open when the magnet goes through each lobe.

Click to Animate

S

N

Drop Out (DO)

Pull In (PI)

□ reference point

Magnet Perpendicular to the Reed Switch

- Magnet is perpendicular to the reed switch

- Bringing the magnet downward through the center of the reed switch

- The contacts will never close.

S

N

Drop Out (DO)

Pull In (PI)

reference point
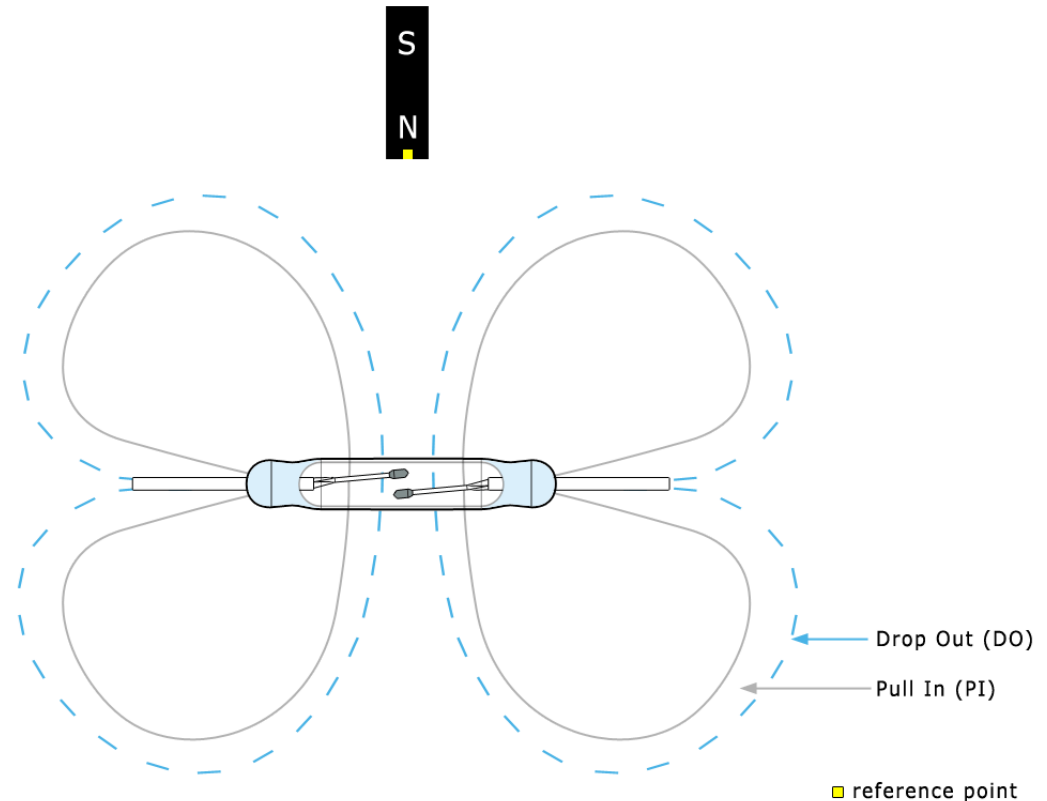
Magnet Parallel to the Reed Switch & Rotated

- When the magnet is parallel to the reed switch the 3 lobes are generated with magnetic sensitivity arrays.

- In this case the magnet is placed inside the pull-in lobe so the reed contacts are closed.

- Now we rotate the magnet 90° about its axis.
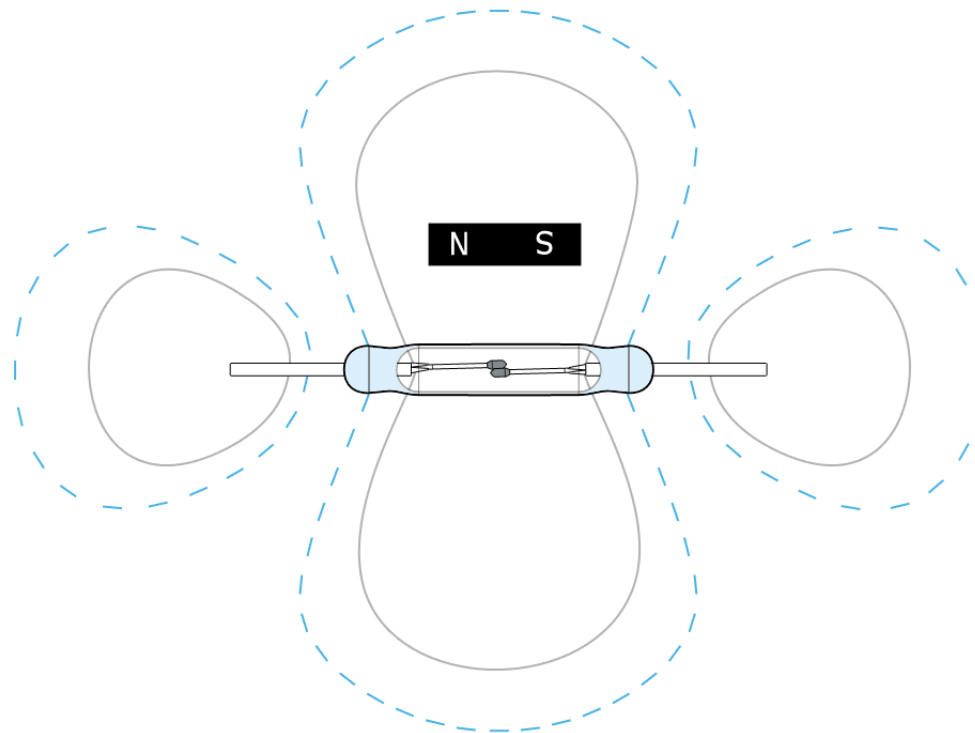
Magnet Parallel & Rotated 90°

☐ The magnet is now rotated 90° making it perpendicular to the reed switch

☐ The magnetic sensitivity lobes now change.

☐ The contacts will now open.
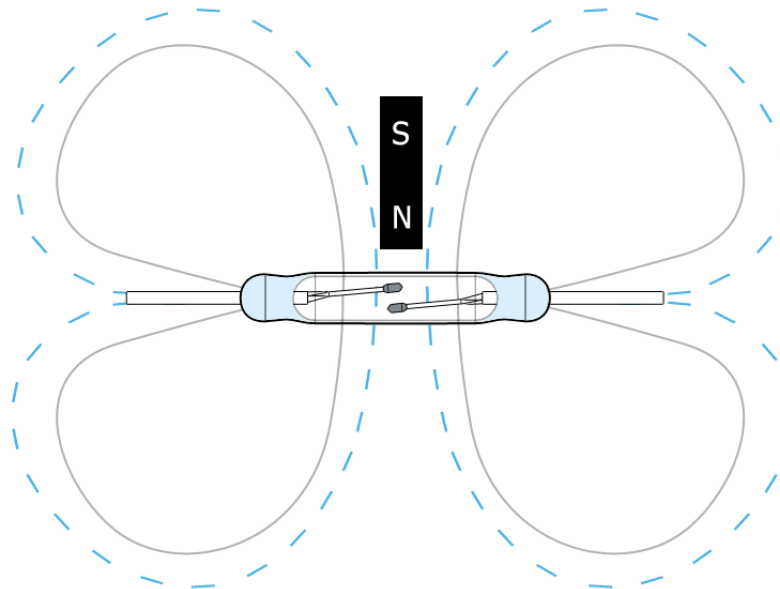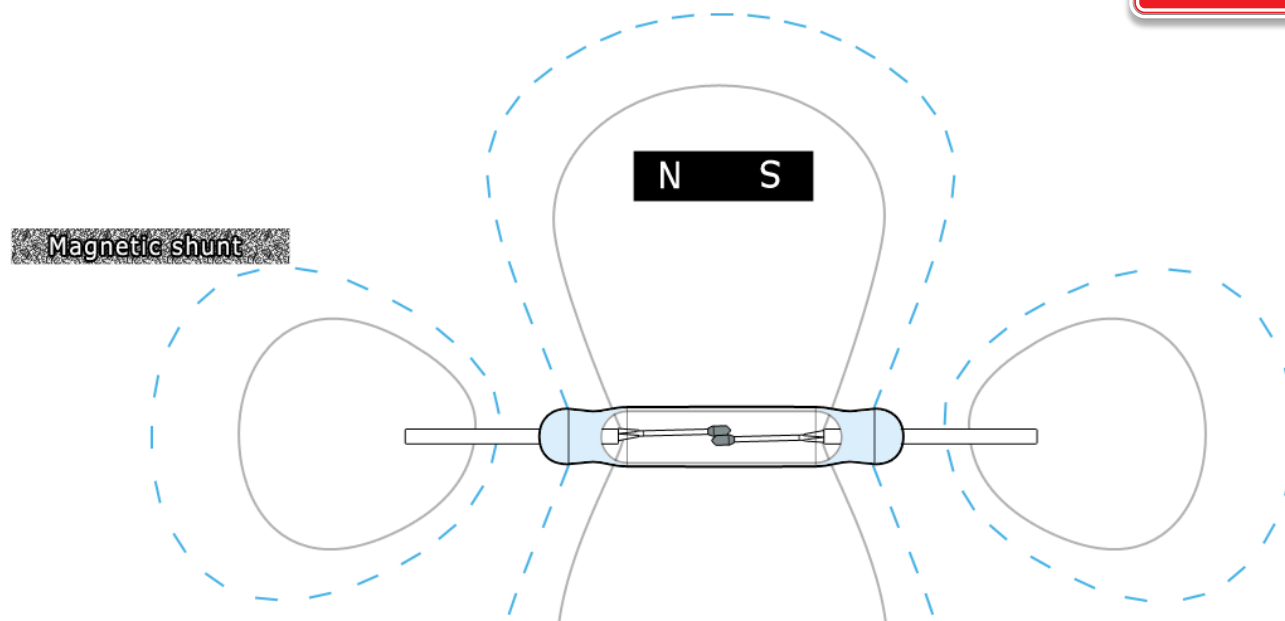
Magnet Parallel to the Reed Switch & Centered

□ With the magnet parallel to the reed switch the typical 3 lobes are present

□ Here the magnet is positioned inside the pull-in lobe.

□ In this case, a magnetic shunt is positioned between the magnet and the reed switch

□ The contacts remain open even though the magnet is within the pull-in lobe
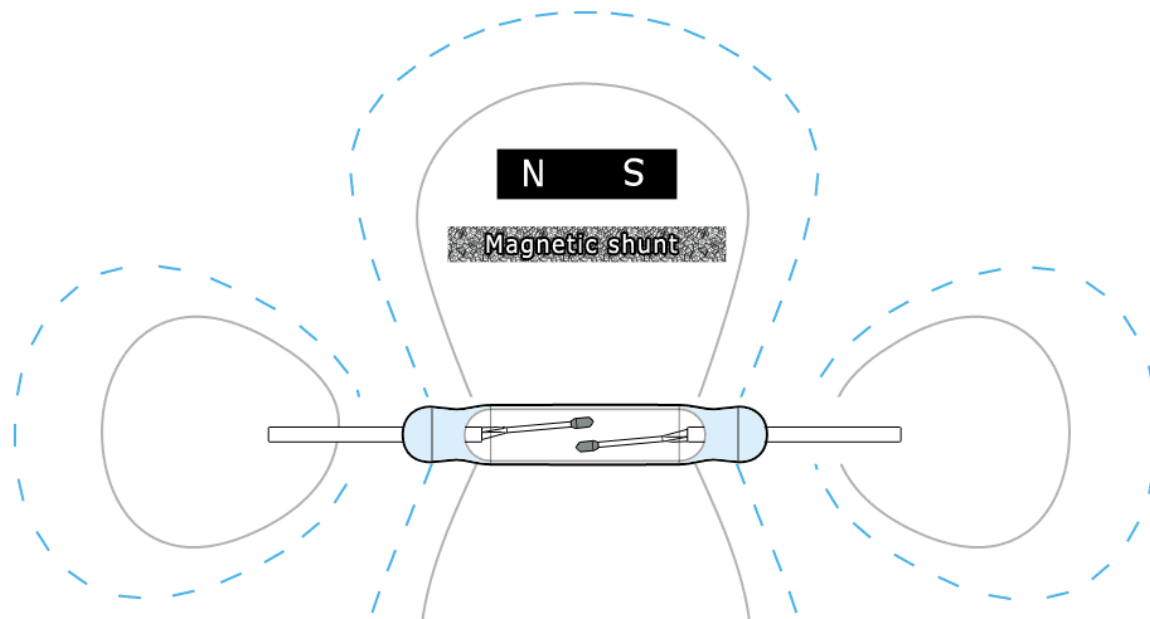
Magnet Parallel to the Reed Switch & Centered

□ With the magnet parallel to the reed switch the typical 3 lobes are present

□ Here the magnet is positioned inside the pull-in lobe.

□ Now the magnetic shunt is removed from its position between the magnet and the reed switch

□ The reed switch contacts now close

Click to Animate

N   S

Magnetic shunt

Three Dimensional Magnetic Fields

3-D Magnetic Field Arrays

Three Dimensional Fields

- The magnetic flux lines emanating from the magnet looks like a beer barrel keg in three dimensions

- With the magnet parallel to the reed switch, the center magnetic lobe array looks like a donut

- The two outside lobes look more like a boxer's punching bag – the kind hung from the ceiling.
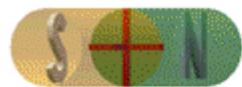
- The magnetic flux and lobe arrays are symmetrical

Magnet

Magnetic lines of flux in 3-D view
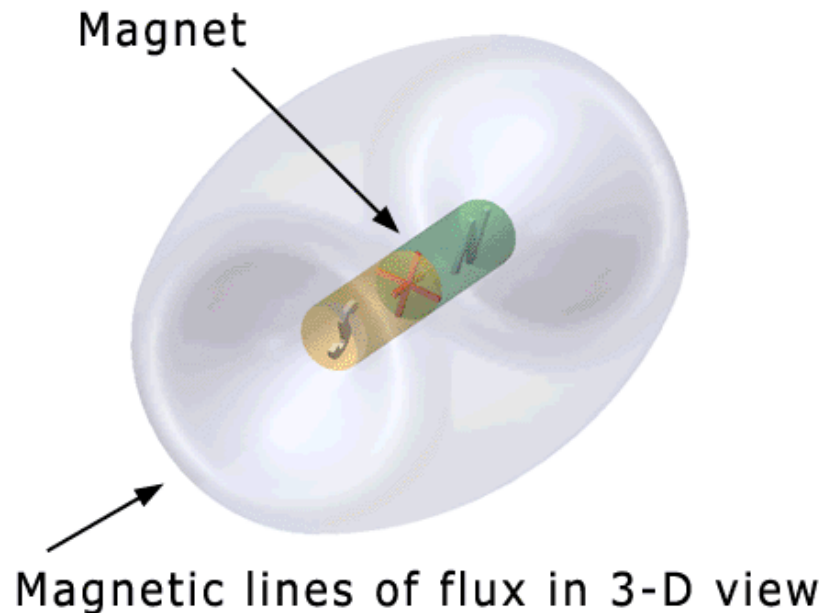
A View of a Three Dimensional Field Array

Click to see this video on our YouTube Channel

Summary

- Reed switch sensors are comprised of a reed switch and a magnet

- The reed switch is packaged appropriately for its application

- The magnet is usually attached to a moving mechanism that allows the magnet to be brought into the reed switch's sphere of influence

- The sensitivity lobe arrays are generated by the influence between the magnet's magnetic flux in association with the reed switch

- Understanding their influence with each other is key to a successful reed sensor application

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