Standex Electronics

Reed Switch & Magnet Interaction

Introduction

Purpose

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

Objectives

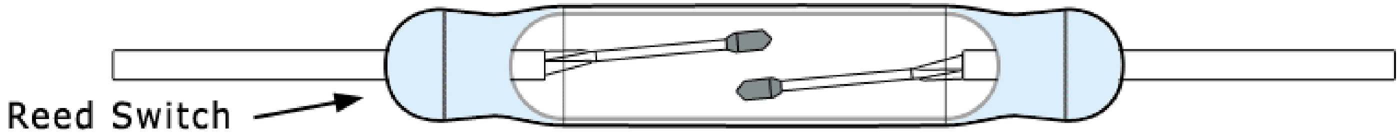
- Define key terms of magnets and reed switches
- Describe the different positions of the magnet relative to the reed switch and its effects in two dimensions and three dimensions
- Describe the sensing function

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

Key Terms

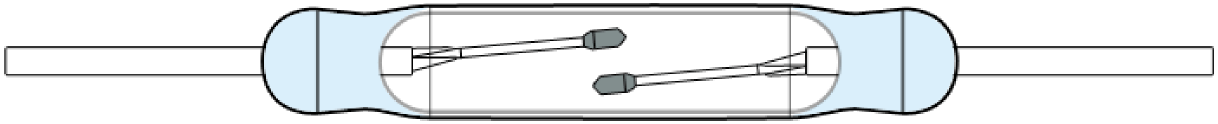


Reed Switch

- 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 Sensors

- Reed switch sensors are comprised of a reed switch and a magnet
- Reed switches are packaged in many ways depending on the application
- The magnet is usually packaged or attached to a moving part
- 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



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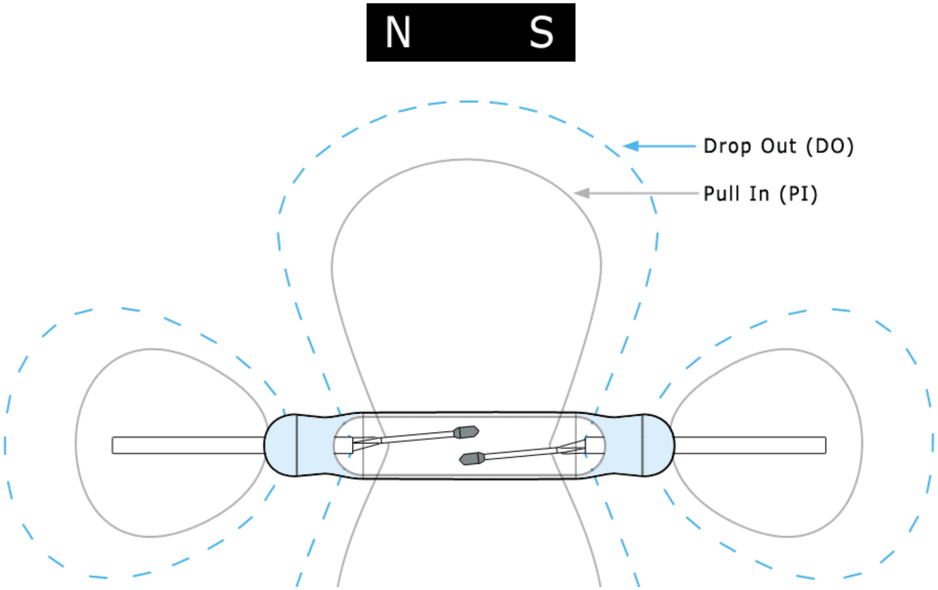
Two Dimensional Magnetic Fields

PARALLEL MAGNET PLACEMENT

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
- 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



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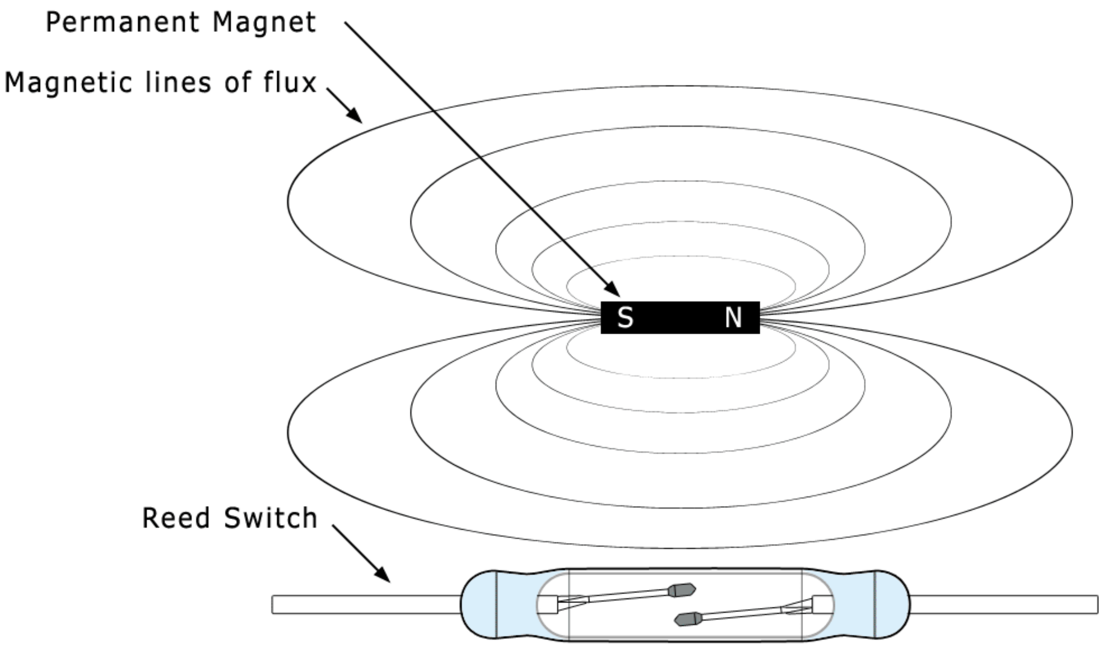
Magnetic Lines of Flux

- 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



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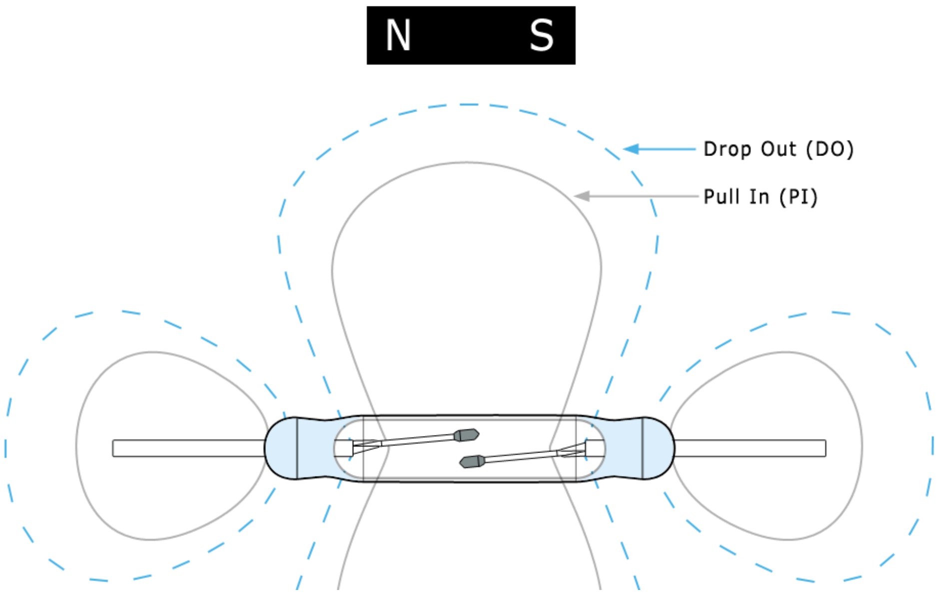
Magnet Parallel to the Reed Switch and Centered

- 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



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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

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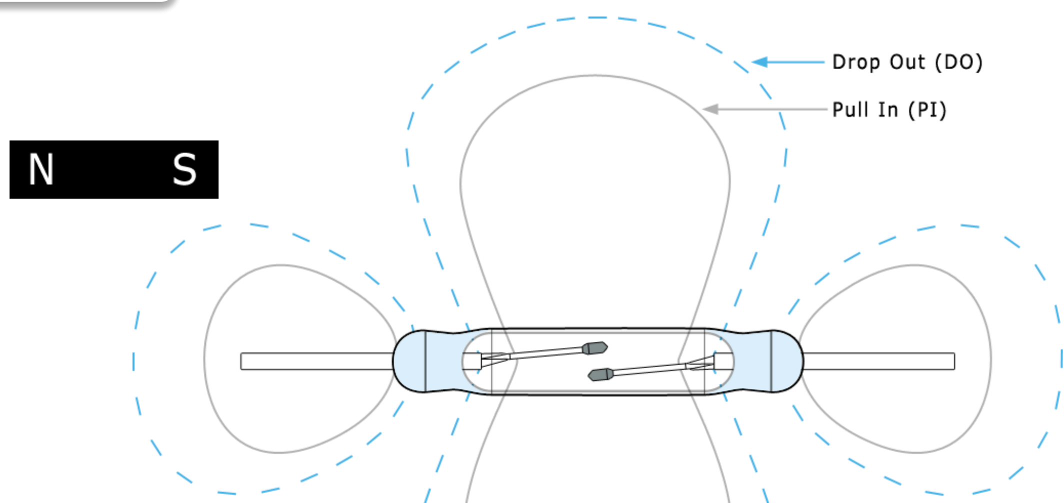

Magnet Parallel to the Reed Switch

- 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

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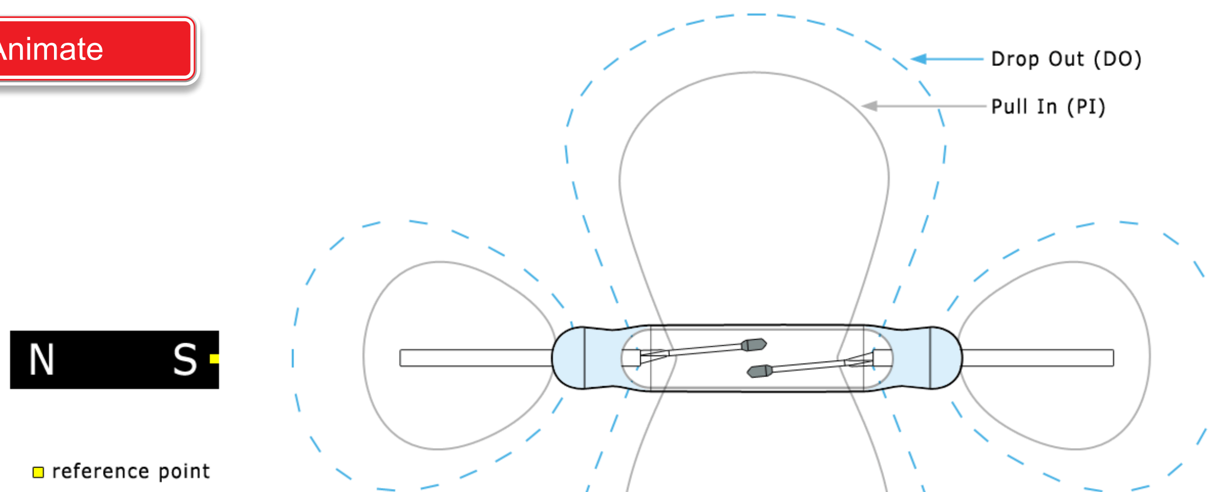

Magnet Parallel to the Reed Switch

- 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

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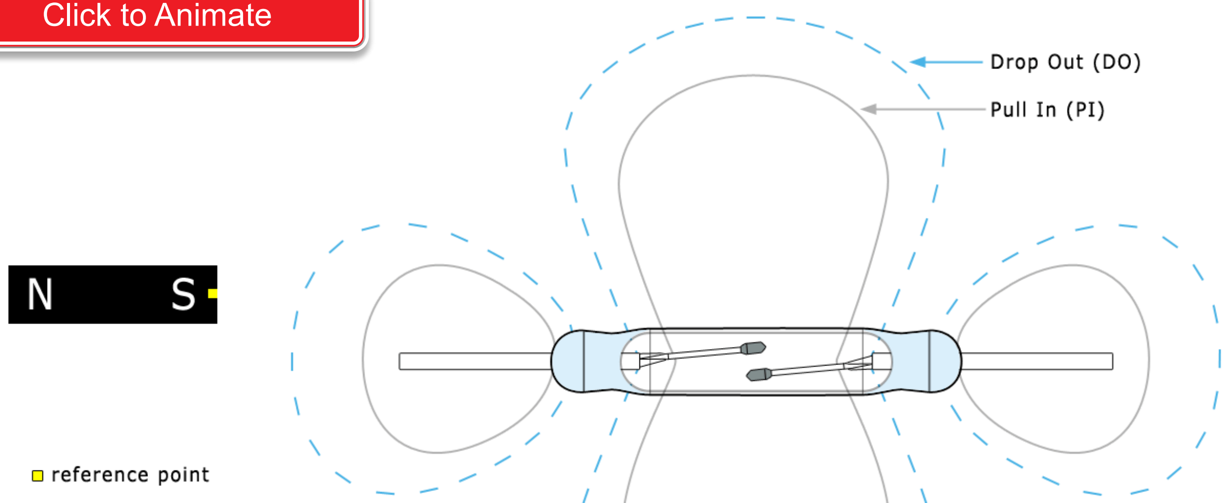
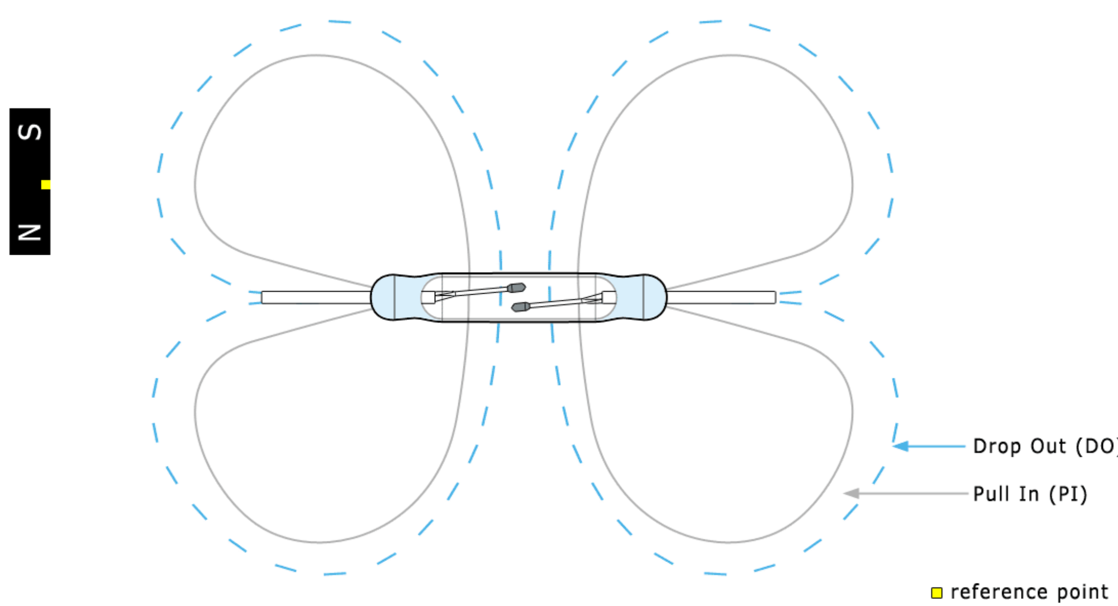


Two Dimensional Magnetic Fields

PERPENDICULAR MAGNET PLACEMENT

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



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

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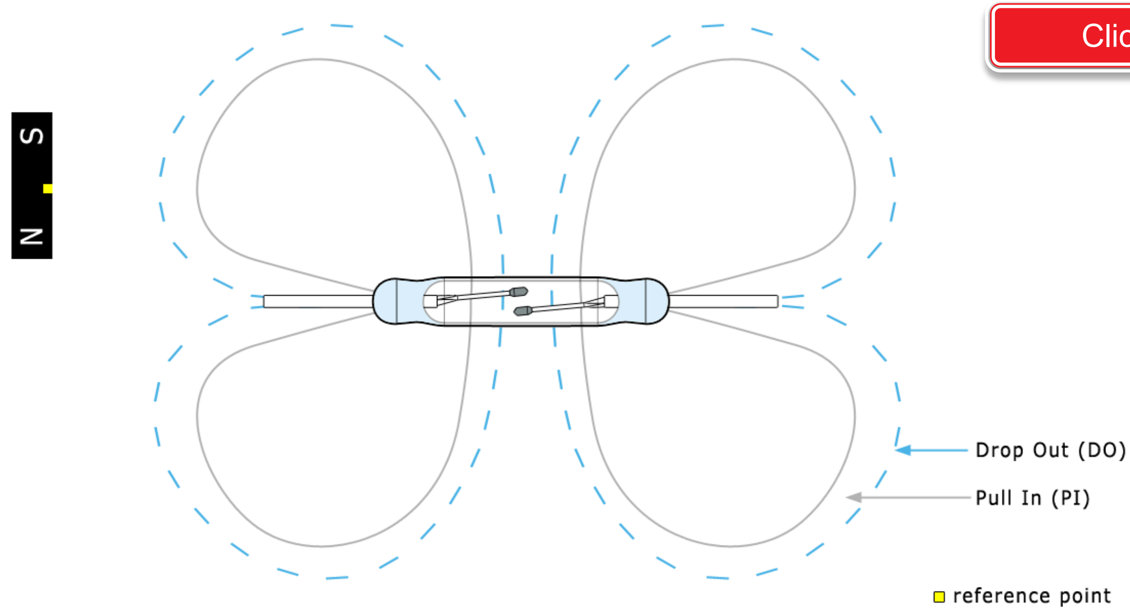

Magnet Perpendicular to the Reed Switch

- 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

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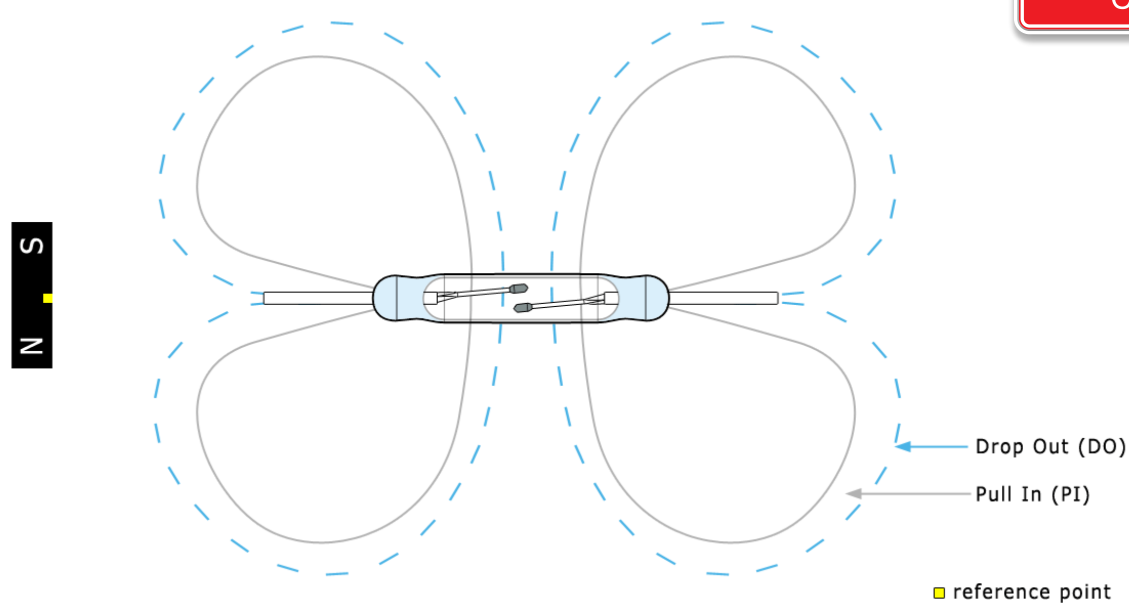
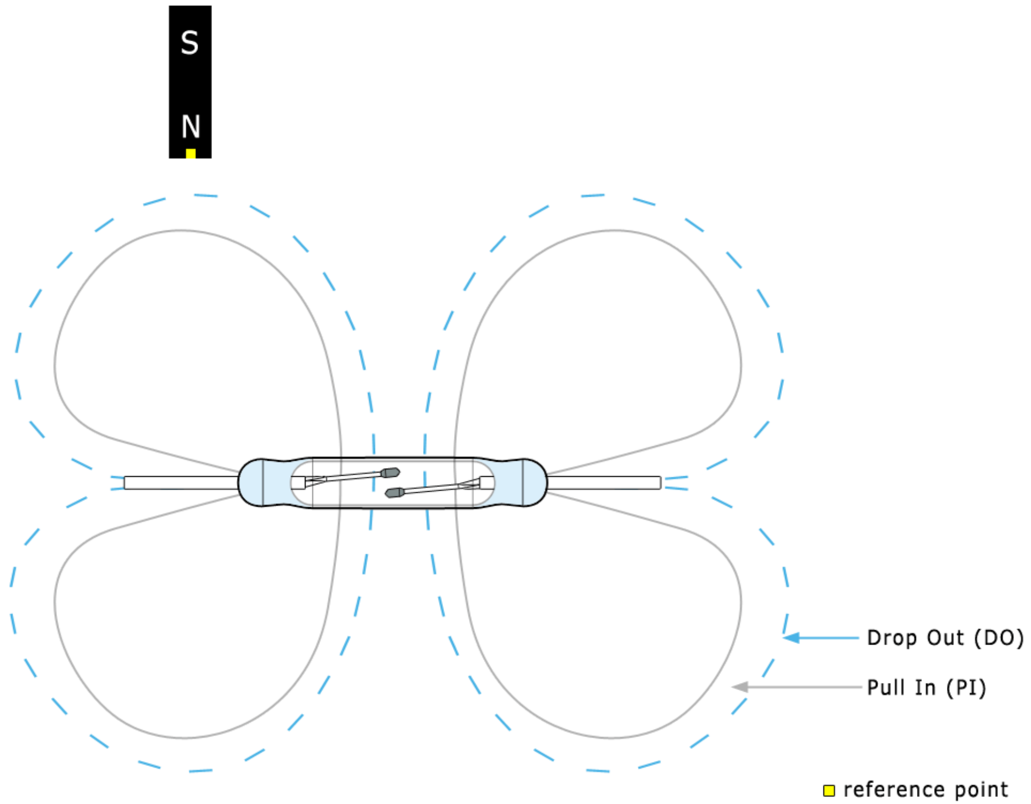


Magnet Perpendicular to the Reed Switch

- 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



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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.

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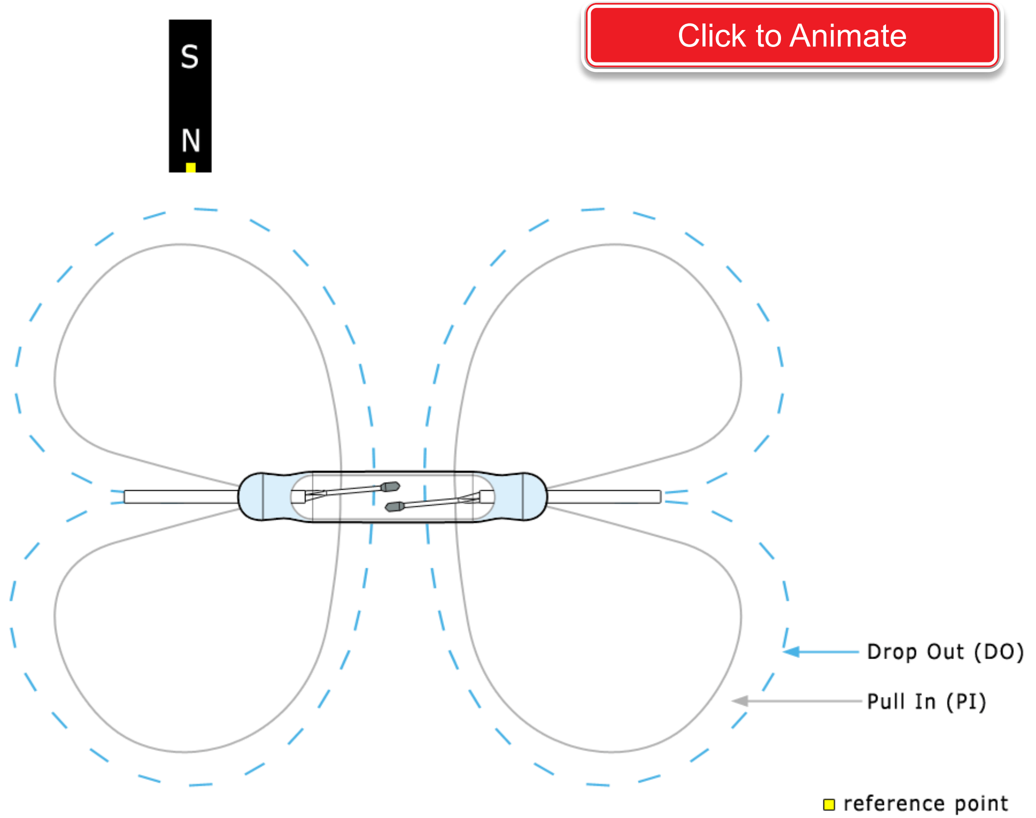
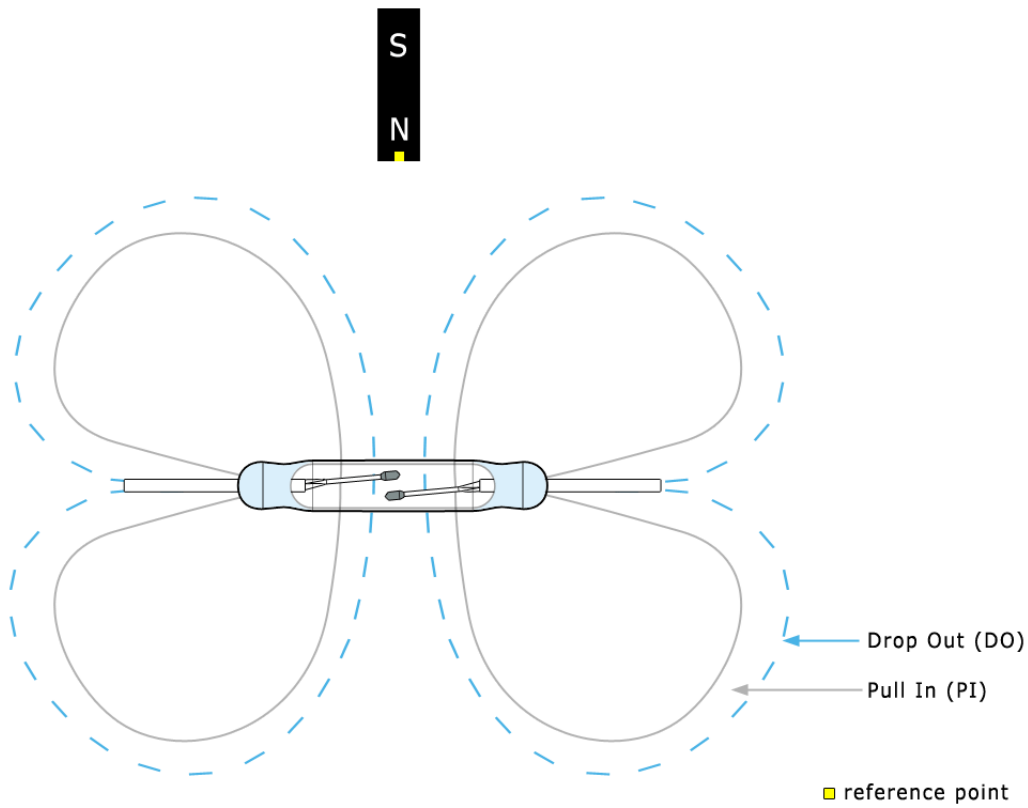


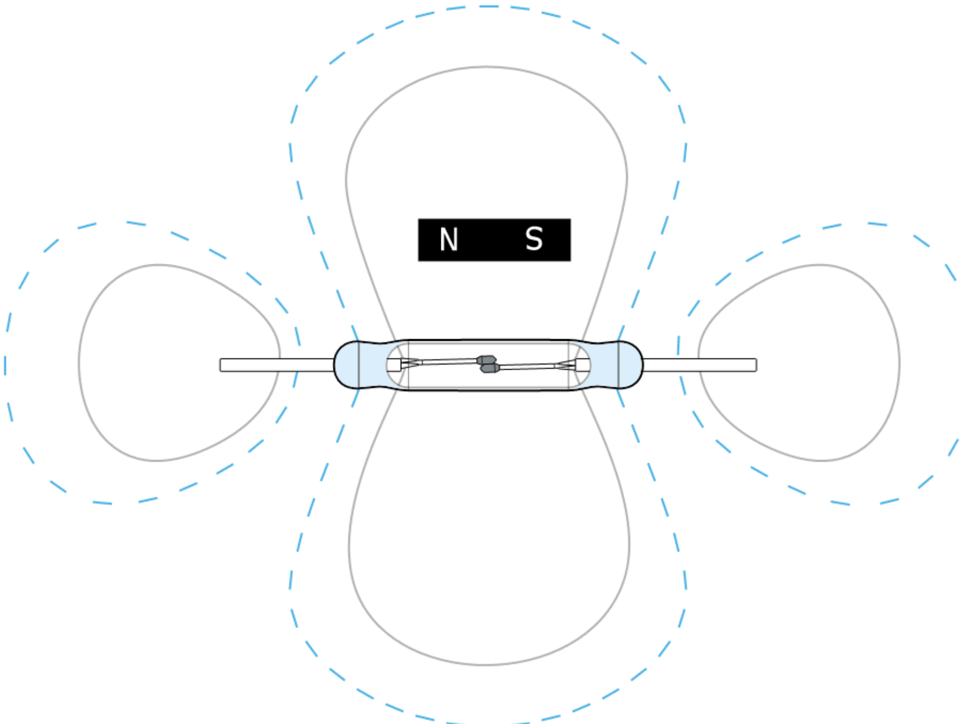
Magnet Perpendicular to the Reed Switch

- Magnet is perpendicular to the reed switch
- Bringing the magnet downward through the center of the reed switch
- The contacts will never close.



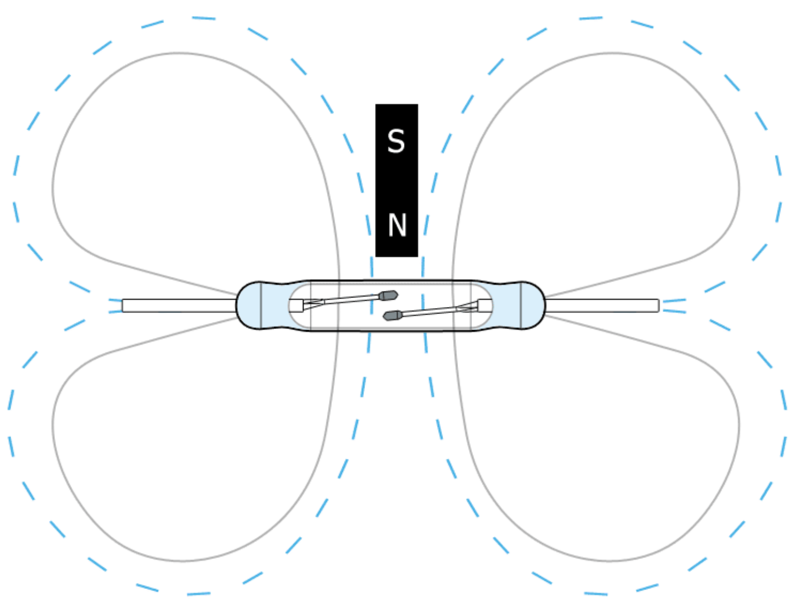
Magnet Parallel to the Reed Switch & Rotated

- 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.



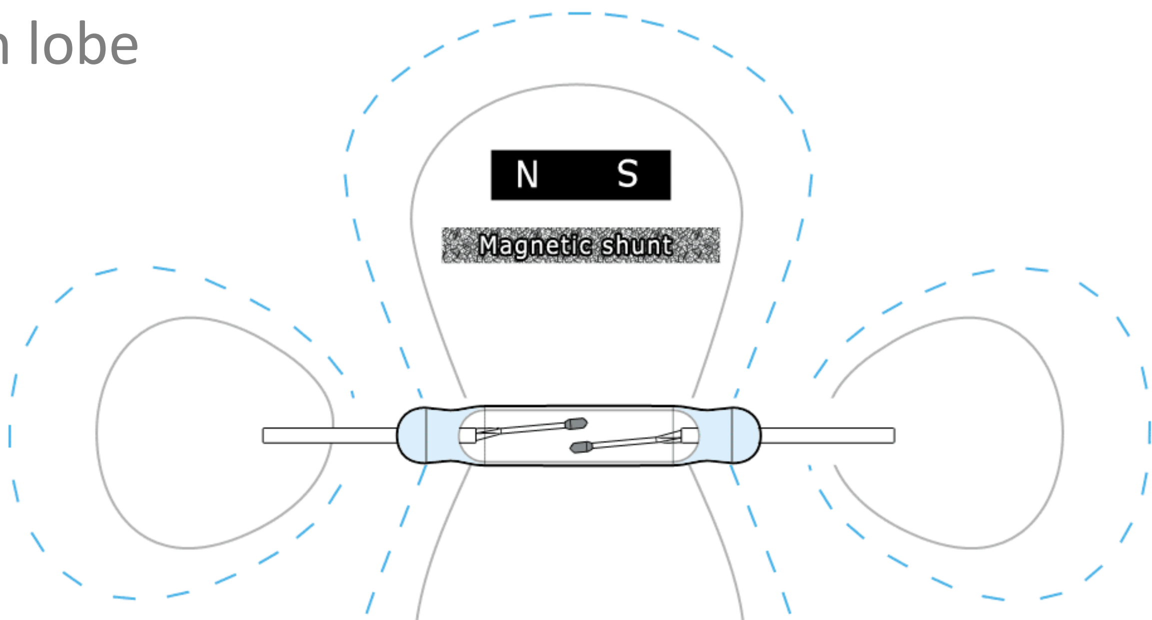
Magnet Parallel & Rotated 90°

- 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

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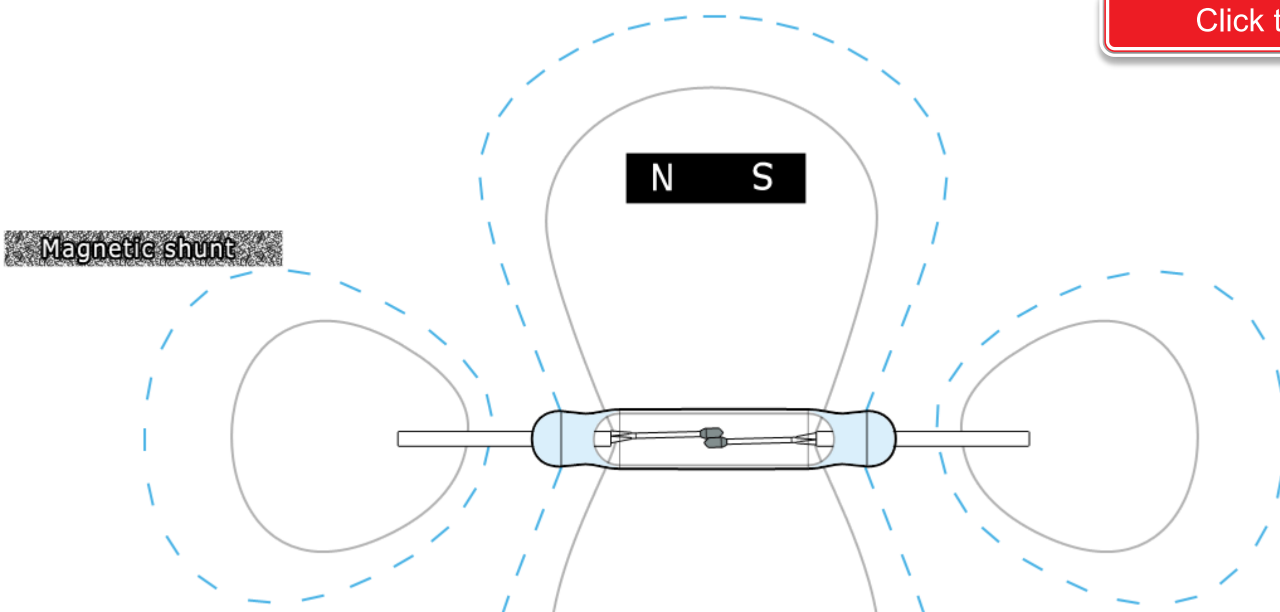

Three Dimensional Magnetic Fields

3-D Magnetic Field Arrays

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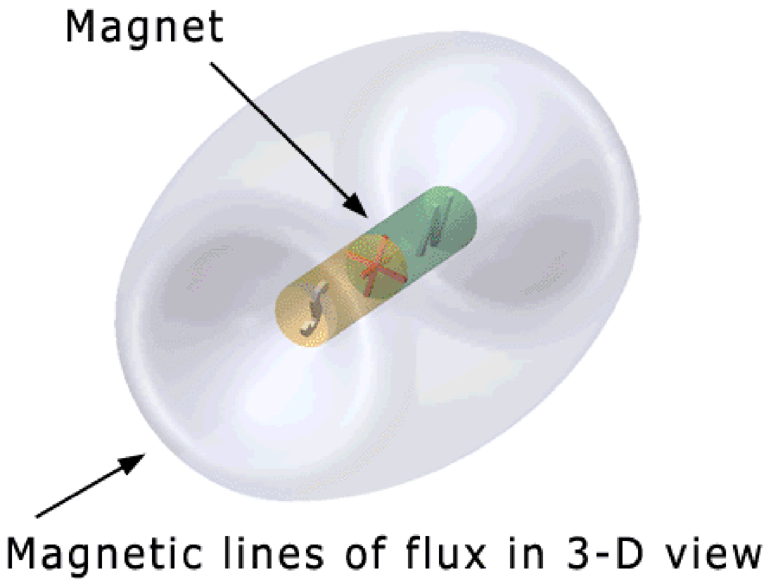
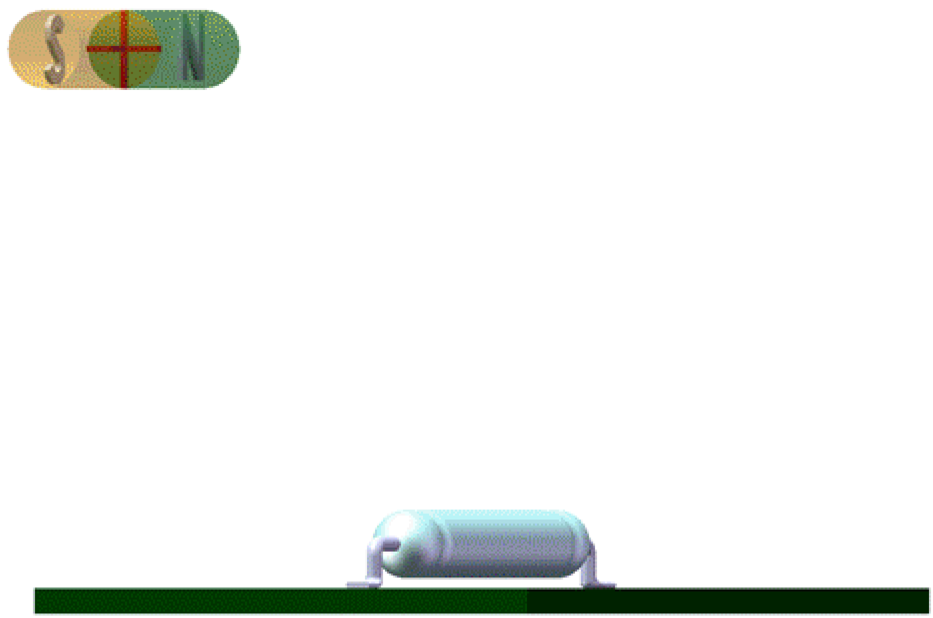
Three Dimensional Fields

- 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



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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