HSI SENSING™
HERMETIC SWITCH INC.

Magnets and Actuators Application Notes

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HSI SENSING
HERMETIC SWITCH INC.

Magnet and Actuator Basics - Environmental Considerations

What is a magnet, and what is an actuator?

For our purposes, the most notable property of a magnet is that it generates a magnetic field that operates a reed switch or proximity sensor.

An actuator is simply a magnet placed in a housing. Customers often pair our actuators with our proximity sensors for a magnetic sensor package. Also, many of the actuator housings provide a way to mount the magnet onto a surface and provide environmental protection.

Basic Types

The three basics types of magnets that HSI Sensing typically uses in applications are Alnico, Ceramic and Neodymium. Each has different qualities and may be impacted by their surroundings.

Alnico

- Alnico rod and bar magnets have high residual induction and energy product compared with ceramic magnets, and low coercive force compared with ceramic and rare earth materials (more subject to demagnetization).
- Temperature stability in high temperature applications, and a maximum working temperature of approximately 1000°F (540˚C).

Ceramic

- Low cost and good holding strength, block magnets offer economical magnet power for price-sensitive applications.
- Ceramic block magnets are charcoal grey in color, and do not appear metallic.
- Ceramic magnets are not suited for high temperature applications (over 250° C).

Neodymium

- Neodymium magnets are the most powerful commercially produced magnets.
- Neodymium magnets are hard and brittle and may chip or break if dropped.
- Neodymium disc magnets are magnetized through the thickness.
- Neodymium magnets are often assembled into products using strong adhesives such as Loctite® 325. Make sure that all contact surfaces are clean and dry prior to bonding.
- Please use caution when handling magnetized neodymium magnets. Their exceptional magnetic force may cause them to attract to metal (or to each other) so strongly that fingers in their path could be pinched or injured.

Magnetic Interference

- In proximity sensor applications, the magnet or actuator is intended to be the single source of magnetic field for operation. Counterfeit sources of magnetism can cause erroneous operation.
- Sources of magnetic interference:
    - Nearby components containing iron or magnetized parts, including brackets, bolts, washers, screws, nails, base metal, and the like.
    - Electronic components manufactured with ferrous materials can generate magnetic fields or become magnetized when exposed to magnetism. Such components include but but are not limited to capacitors, batteries, motors, wire, and transformers.
- Any of these components can reshape or even significantly weaken the magnetic field when they are close to the magnet. Non-ferrous mounting hardware is recommended.
- Consider the chemical resistivity of your magnet and/or actuator housing based on your applications environment.

Magnet and Actuator Operation

With a Reed Switch

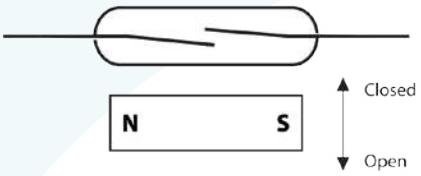
With a Magnet

A reed switch is activated by a magnetic field. It's important to realize that there are numerous possibilities for orientation of a switch within a given magnetic field. The diagrams on the next page show several basic examples of reed switch operation with the use of a moving and stationary magnet.

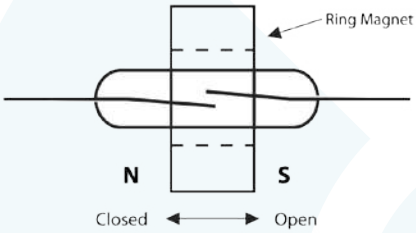
The length of the magnet and the length of the reed switch both affect the magnetic field coupling.

The physical parameters of a magnet–such as length, width, thickness or diameter–impact the size and shape of the resultant magnetic field. For example, an M-01 (.062 h/w x .50 length Alnico) must be very close to a reed switch to ensure operation, while an M-15 (.250 dia. x 2.25 length, Alnico) will operate a reed switch at a much greater distance.

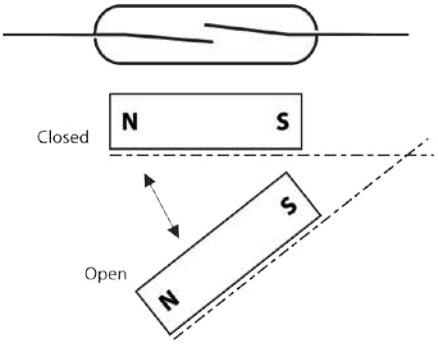
As explained on the previous page, reed switches are activated by magnetic fields. It's important to realize that there are numerous possibilities for a switch's orientation within a given magnetic field. On this page, you can see several basic examples.



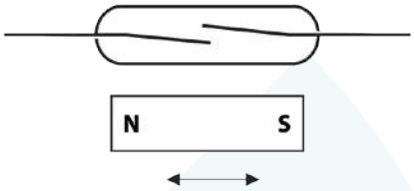
A magnet moved in a front to back motion (perpendicular towards and away) will operate the reed switch



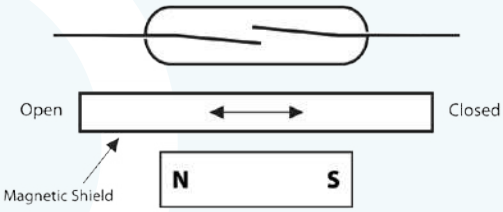
A reed switch moving through a circular/ring magnet will operate up to 3 times.



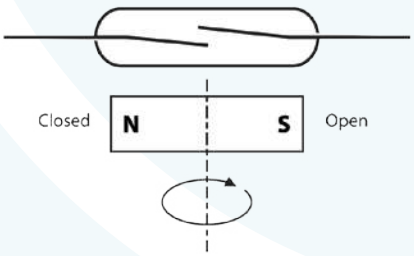
A pivoting/swinging magnet will operate the reed switch.



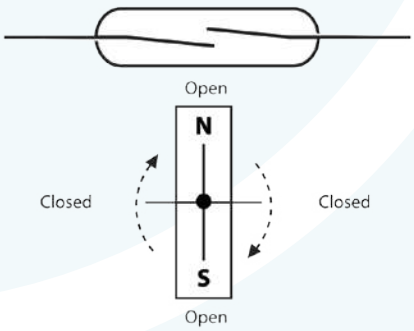
A reed switch can operate with a magnet moving parallel to the reed switch.



Shielding (Indirect Actuation):
If the reed switch and magnet are stationary, the movement of a shield (made of ferro-magnetic material) between the switch and the magnet will open and close the switch's contacts. The shield is used to divert the magnetic field away from the switch.



Rotation:
Magnets can be rotated several different ways to operate the reed switch. For more information on the effects of rotary magnetic motions, contact HSI Sensing.



Common Paths of Reed Switch Activation...

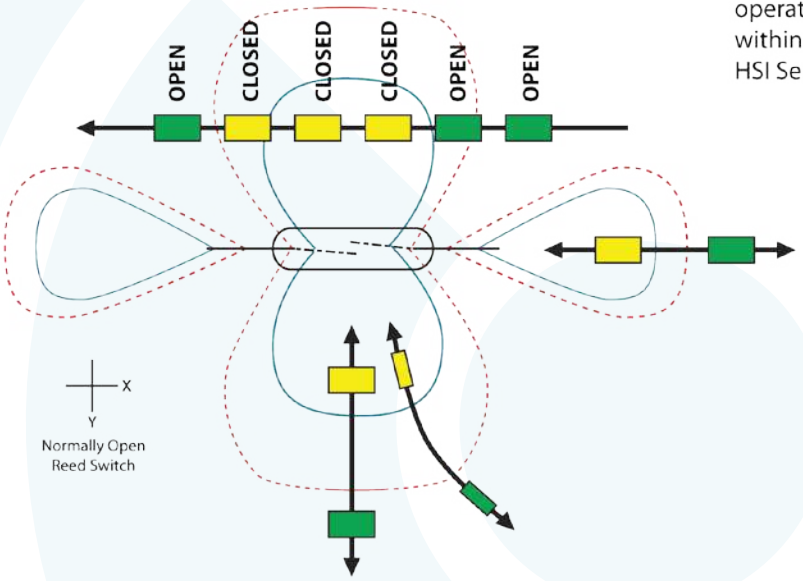
A magnet's path

The magnet is activating the switch

The magnet is not activating the switch

The point of activation, also known as Operate or Pull-In

The Point of de-activation, also known as Release or Drop-Out



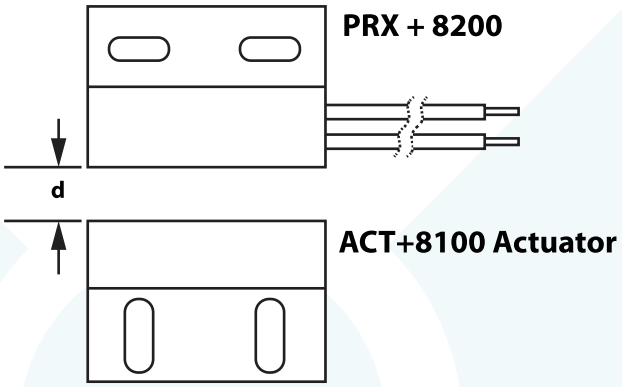
A magnet can actuate a reed switch several different ways. The drawing below demonstrates several common paths a magnet travels to operate the switch's contacts. The blue line represents the point at which the switch is activated by the magnet (also called the Release or Drop-Out). As shown in the drawing, a magnet must pass the Operate point (blue line) for the switch to be activated. To de-activate the switch the magnet must travel outside the Release point (red dotted line).

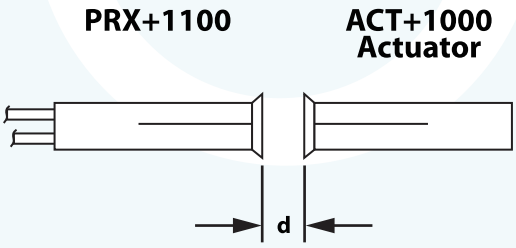
If you have specific questions about the operation of a reed switch, especially within a certain application, please contact HSI Sensing.

With a Proximity Sensor

For proper alignment, position and location, please refer to the product specification sheet. An example is provided below.

Please note that a shorter magnet or actuator has a shorter field, and a longer magnet or actuator has longer field.





Magnet and Actuator Handling

Disengaging Magnetized Magnets

Individual magnets must be pulled from the row horizontally. See images below.

- Do not slide magnets against each other
- Do not allow magnets to cluster

Connecting Magnetized Magnets

Group magnets that are magnetized, allowing the magnetic fields to attract from end to end (forming a row). See Figures 1, 2, 3 and 4.

- Do not allow magnets to cluster.

CORRECT

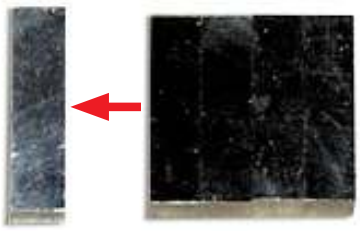


FIGURE 1

CORRECT

FIGURE 2

INCORRECT

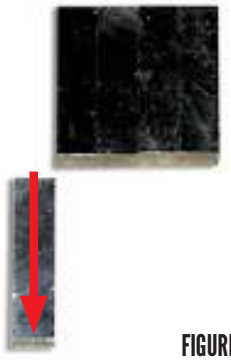


FIGURE 3

INCORRECT

FIGURE 4

CLUSTERED MAGNETS

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